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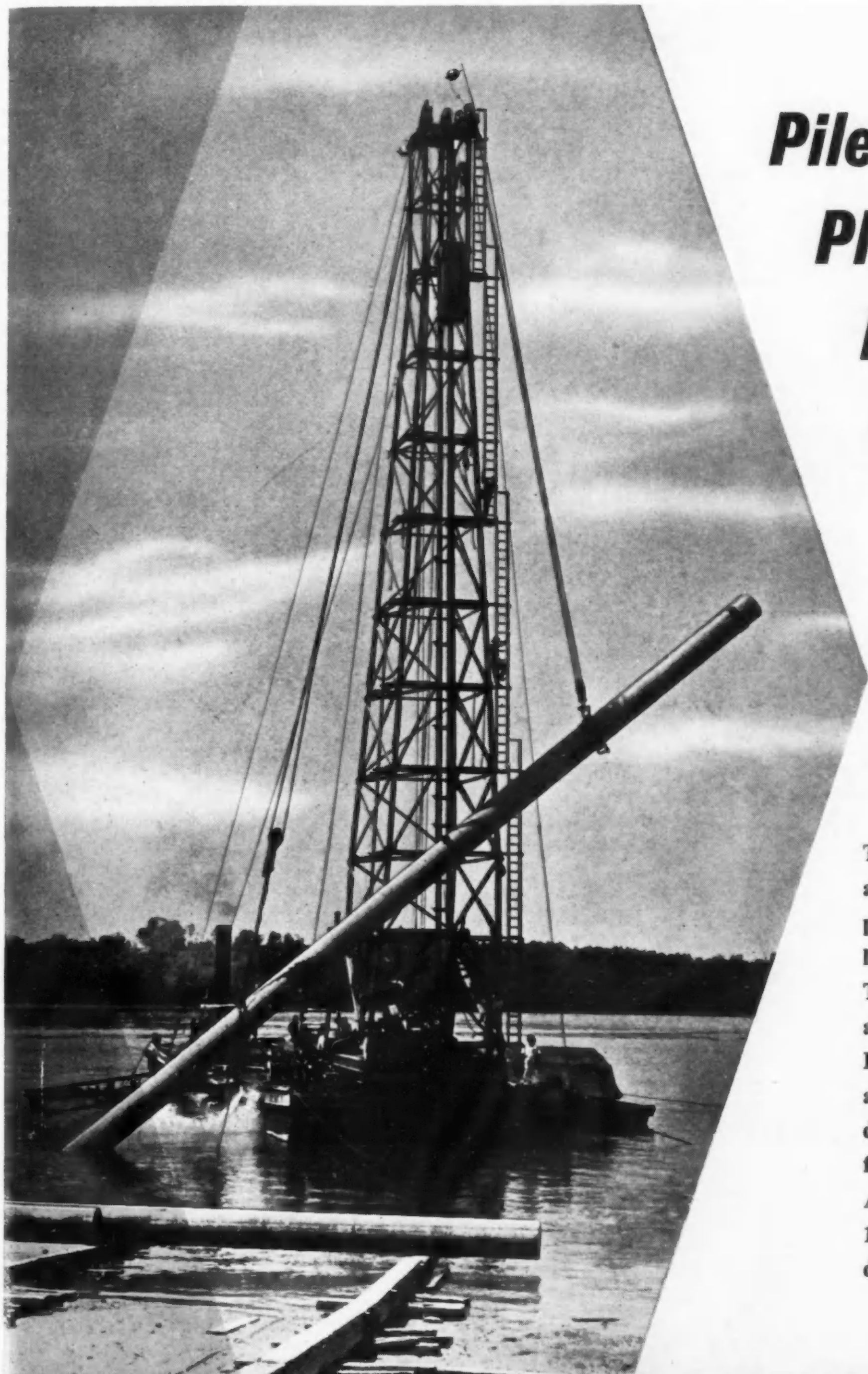

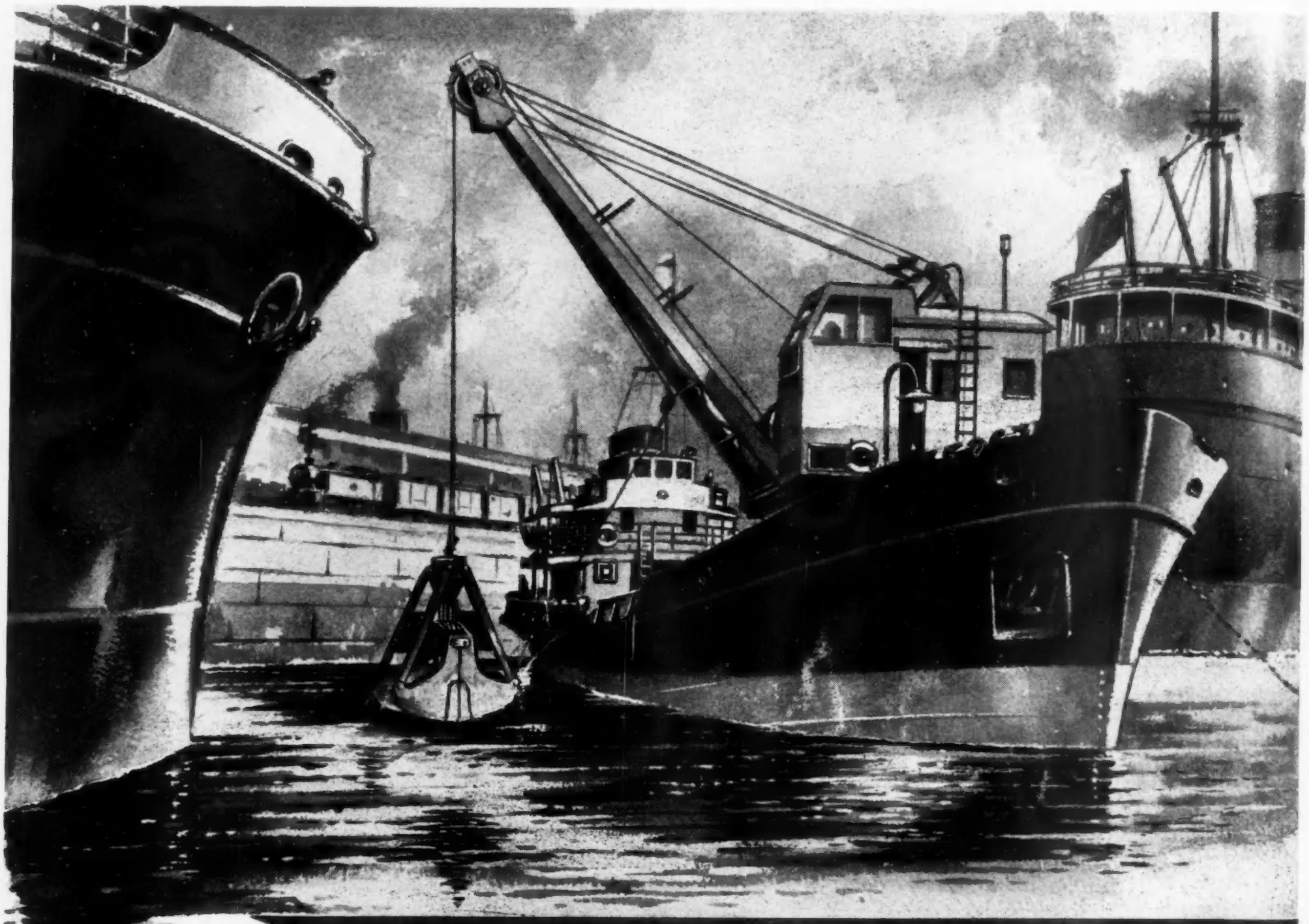

The Dock & Harbour Authority

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No. 456

Vol. XXXIX

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Editorial Notes

The Port and Colony of Hong Kong

Our leading article this month gives some interesting information about the Port of Hong Kong. Since 1945, the development of this British Crown Colony and Port has been phenomenal—it has not only regained its position as one of the world's greatest entrepôts, but also has developed a number of important manufacturing industries which have made the Colony less dependent upon its previous trade with China.

The principal reasons which have enabled Hong Kong to achieve such a rapid recovery from the chaos and devastation inflicted during the Second World War, are its confirmed policy of free trade, its stability and political security, and its strategic location, as the port possesses a fine natural harbour which is the only safe deep-sea anchorage between Shanghai and Indo-China.

Shipping companies of every maritime nation maintain regular services with Hong Kong and, now that her new industries are becoming firmly established, there is every prospect that the Colony will continue to hold an important position in the general economy of South-East Asia.

The Problem of Preventing Dock Strikes

Now that the findings of the Cameron Court of Enquiry have been accepted by both the Port Employers and the Unions, there should be a quiet and reasonable atmosphere in which the subject of dock strikes and their prevention can be considered. We are therefore publishing in this issue an article which, though provocative, is nevertheless an attempt to face up to the realities of a difficult problem.

While it is the policy of "The Dock and Harbour Authority" to allow freedom of expresison to its contributors, the views put forward are not necessarily those of the Journal. Indeed, we do not agree with all the views adumbrated in this particular instance and we anticipate our readers will find themselves agreeing with and differing from our correspondent on many issues.

Although the author has had more than 40 years' experience of the dock industry, he does not lay claim to knowing all the answers and, as he himself points out, his contribution is put forward to invite contradiction and engender interest, so his proposals are unlikely to find general acceptance.

There is no doubt that dock strikes (usually unofficial) eventuate with consistent regularity and thereby jeopardise our whole economy by appreciably increasing handling and shipping costs. There is also no doubt that any proposals or changes in the dock labour scheme arouse bitter opposition from different quarters, as many of the protagonists have a "vested interest" in maintaining the status quo. Nevertheless, it is equally true that the present labour arrangements for the port industry of this country are unsatisfactory and something fundamental must be done to effect an improvement.

It therefore is to be hoped that the present article will evoke reasoned comment and enlightened discussion, which will not be only of academic interest, but which will put forward practical suggestions to those responsible for maintaining efficient working relations throughout the industry.

A Shipyard "Bubble"

Plans to establish new shipbuilding yards are being mooted with increasing regularity from all parts of the world. Recent announcements of such projects include *inter alia* new shipyards in Greece, in Southern Ireland, in India and in South America. This urge to compete in a market which is already experiencing severe international competition is economically unsound and, if persisted in, will probably involve the promoters of such schemes in heavy financial losses.

A pertinent comment on the present trend appeared in the issue of "Lloyds List" for August 6th last in an Editorial note which carried the above title and read as follows:

"One of the aspects of the wave of nationalism which seems to be sweeping the world at present is the desire to possess a shipyard. At one time a new shipyard was "news,' now it is becoming almost a weekly occurrence, and it is interesting to see how this type of information has slipped from the top to the bottom of the columns in the shipping publications. In fact, a new yard nowadays often demands less attention than the launching of a tramp ship. One thing that is unfortunate about it all, however, is the fact that these yards are being foisted on to a world which already has too much shipbuilding capacity. In many of the countries now entering the industry, it is obvious that there will not be enough home work to keep the yards gainfully employed. They will, therefore, have to try to obtain contracts from abroad — from the traditional maritime nations. And, since the traditional maritime countries already have their own well-established shipbuilding industries the newcomers will have to offer some very attractive inducements. They will in the first place be able to offer early delivery—not that this is much of an inducement these days—and they might also be able to offer cheaper prices on account of lower wage bills. But, against that they have to compete with a wealth of shipbuilding experience, and the mutual trust built up between builder and owner over the years. The present demand for new yards reminds one of the canal boom in Telford's day and the later railway mania of Brunel's era. It is like an ever-growing bubble; and bubbles, as we all know, eventually burst. It is hard to believe that this one will be the exception."

National Dock Labour Board Levy

The National Dock Labour Board announces that the rates of percentage payments on the gross wages of registered dockworkers are to be increased as from normal finishing time on Saturday, November 1. The rate on the gross wages of daily workers employed on work other than coastal traffic will be increased from 12 to 13½ per cent., and on weekly workers employed on coastal or other dock work, from 4 to 4½ per cent. The percentage payments on the gross wages of daily workers employed on coastal traffic will remain unchanged at 8 per cent.

In a statement the National Dock Labour Board refers to the continued decline in the volume of employment on the docks and states that there are, as yet, few signs of an early recovery. During the summer months the absence of large numbers of men on

Editorial Notes—continued

annual holiday retarded the pace at which the Board's reserves have been used, but with the passing of the holiday period and and consequent rise in the available labour force, the drain on these resources is inevitably intensified, and it is estimated that for the year as a whole a deficit of more than £1 million will have to be met from Levy Stabilisation Fund.

Some progress has already been made, and further steps are being taken, to bring the size of registers more into line with immediate requirements for labour. This process will inevitably be gradual and, in the meantime, it must be expected that with a continuance of the present level of employment the recent increase in the rates of wages will be sufficient to produce a net gain to the Board's income and expenditure position.

The Board has deferred a decision on the rates of percentage payments in recognition of the difficulties with which the industry has been and still is faced, and the problems of coastal shipping have throughout been given special consideration. It has, however, now reluctantly decided that modest adjustments in other rates cannot be further delayed. The increase in the rates of percentage from November 1 will have little effect on the results for 1958 and on the basis of current estimates they will not suffice to prevent further calls on Levy Stablisation Fund during 1959; they are primarily designed to cover the increase in National Insurance payments and the increases in the attendance and guaranteed make-up payments, and only when better employment returns will they serve to restore in part the resources upon which reasonable stability in the rates of levy depends.

Flexible Barges for the Carriage of Liquids

A full-scale demonstration was given on Southampton Water last month of a flexible barge capable of carrying for long periods a cargo of kerosene or other mineral oils. This new method of transporting liquids that are lighter than water has been developed by Professor W. R. Hawthorne, F.R.S., Sir Geoffrey Taylor, F.R.S., and Mr. J. C. S. Shaw, M.A. of Cambridge University who, since 1956, have been studying the problems of containing oil in a flexible skin and of conveying it through water.

The Dracone (the name is derived from the Greek for serpent) demonstrated was 5-ft. in diameter and 100-ft. long having a capacity for 10,000 gallons of kerosene, weighing approximately 40 tons (specific gravity 0.796). The flexible skin of the container is made of woven nylon fabric with synthetic rubber coatings inside and out capable of resisting petrol or fuel oil on the inside and sea water and sunlight on the outside. It was towed at speeds ranging up to 5½ knots on a fairly short towline

Considerable experimental work was carried out prior to the building of the first operational Dracone. In the spring of 1957, a smaller model, 3-ft. in diameter and 67-ft. long with a capacity of 10 tons was tested on the River Great Ouse. Good results were obtained and subsequently Dracone Developments Ltd. was formed with the support and financial backing of the National Research Development Corporation. Further testing of the ten-ton model was carried out in Harwich Harbour and the North Sea under conditions ranging from a calm to a gale. Under all these conditions, the model behaved as predicted and the practical experience gained enabled still larger sizes to be designed and developed.

During these tests, means of preventing yawing and snaking were further developed. Various experimental techniques were tested and it was found that the model Dracone could be towed straight at the cost of a small increase in drag. The model could ram a river bank at a speed of 5-ft./sec. without any harm, the nose taking the shock and transferring it to the fluid. It was also found that the model could be turned in much less than its own length by allowing it to form a fold which travelled from end to end.

In commercial use, the Dracone will be filled and emptied by a pipe attached to the stern and liquid will be pumped in or out either from a tanker or from the quayside. When empty, it can be wound on to a large floating reel which can be lifted on to a quay or pulled up a beach or slipway. There it can be easily removed and rolled or folded for storage. This flexible barge apart from solving normal barging problems, should therefore be useful in remote places, as it can be quickly shipped by air or sea for immediate use.

It is expected that capital and operating costs will be considerably less than for the equivalent size of conventional barges. The long, thin shape of these containers enables relatively high speeds to be obtained economically.

Plans are in hand for further trials at sea with the 40-ton prototype barge. These tests will be fully instrumented. While this size is regarded as a preliminary step to barges of much greater capacities it is evident that relatively small barges will be suitable for transport on inland waterways. Indeed, while the original scheme was for large-scale ocean transport of oil, it is now clear that there exists a wide market for the transport of many types of liquids and certain solids in flexible containers of various sizes.

Port of London Authority Improvement Scheme

The Port of London Authority have approved a scheme of improvement works to be carried out at No. 4 Berth on the south side of the Royal Victoria Dock. This is the last site available for development in the Royal group of docks, and the estimated cost of the works is approximately £600,000.

The work involved in the scheme provides for the extension of the quay wall eastwards to increase the effective length of the berth by 80-ft. to 1,150-ft., construction of a new steel sheet piled cross-wall northwards from the extended quay, and removal of a large spoil heap running northwards to the Connaught Cutting. The berth will be dredged to allow a depth of 31-ft. below impounded water level overall. Work to be carried out on the quay includes the erection of a transit shed 700-ft. by 200-ft. with covered loading bays at each end (approximately twice the size of a normal transit shed, thus enabling cargoes for two vessels to be dealt with at the same time). The existing crane track, at present 475-ft. long, is to be extended along the whole length of the two berths. Equipment to be installed at the berths includes four 5-ton cranes and three 3-ton cranes of 80-ft. radius.

The berth will be used by vessels of the United States Lines, with whom an agreement for its use has been concluded between the shipping company and the Authority. It is to be developed on the most modern lines to allow the maximum use of mechanical handling equipment. Special consideration is to be given to facilities for container traffic now being delivered by the company on its Trans-Atlantic service. It is hoped that the berth will be ready for use within a year.

Increased Grain Storage Facilities at Leith

Recently the new extension to the Imperial Dock grain elevator warehouse at Leith commenced operation. The extension provides storage capacity for a further 15,000 tons of grain, bringing the total capacity of the port to 71,000 tons. The cost of the scheme is estimated at £300,000.

For many years the import of grain has represented one-third of the total import tonnage of the port and the first grain warehouse at Leith Dock was built in 1903. It had a capacity to store 20,000 tons of grain in timber silos, and was taken over by the Leith Dock Commission in 1906. This original warehouse was destroyed by fire in 1930, but the total silo storage capacity was re-established at 36,000 tons in 1934. In 1946, Joseph Rank, Ltd., negotiated with the Commissioners for the construction of a new flour mill and silos at the western harbour, and it was thought this additional storage for 10,000 tons, later increased to 20,000 tons, would be adequate to meet all requirements at Leith. By 1956, however, it became evident that additional storage accommodation would have to be provided and the Commissioners decided on the present scheme.

The new structure, 140-ft. by 90-ft. and 90-ft. high, contains 70 silos of equal size and each capable of storing 225 tons of wheat. The design of the building conforms with the current code of practice for reinforced concrete buildings and several modifications are incorporated to reduce cost without any sacrifice of strength.

Construction of the installation commenced in May, 1957, and the handling machinery was installed in March, 1958. Although the new plant for dust extraction had not been completed, the Commissioners were able to make full use of the storage space in the new building by the end of July and it has been in constant use since that date.

The Port of Hong Kong

It's Growth and Development as the Main Entrepôt of the Far East

By ERIC FORD, B.Sc.(Econ.), B.Comm.

IN spite of the fact that Lord Palmerston, then British Foreign Secretary, remarked at the time of its annexation in 1841 that "Hong Kong will not be the mart of trade," this Far Eastern Colony has in fact become one of the world's most important ports. Shortly after his Lordship had uttered this dictum, the "Canton Press" also wrote disparagingly about the prospects of the new British trading post, remarking that it lacked everything necessary for a successful port except "abundant supplies of granite and cold water."

Although it might appear to a modern eye that a natural anchorage, providing 17 square miles of land-locked water for ocean-going vessels drawing up to 36-ft. of water, would be an acquisition of which any nation might well be proud, it was only historical necessity which forced Captain Charles Elliot, R.N., as Superintendent of British Trade in China, to accept Hong Kong as a British trading post when forced to evacuate Canton. The island, then only known as a retreat for pirates, with a small permanent population of fishermen and farmers, was formally occupied on January 26th, 1841.

Shortly afterwards, the unfortunate Captain Elliot was dismissed for his part in the negotiations.

Indeed, it seemed at the outset as though the critics were to be justified for during the first few years of the Colony's existence, the Chinese market quarter was twice burnt down, two disastrous hurricanes hit the island and a mysterious disease decimated the population.

Nevertheless, almost from the start it was evident that a considerable trade future faced the island for as early as 1844 it is recorded that no fewer than 538 vessels, with a total tonnage of 189,257 tons, entered the harbour. By this date the population had reached 19,000 while in the following year the first monthly mail service was started between Hong Kong and Europe.

Under the Treaty of Peking in 1860, a part of the Chinese mainland to the north of Hong Kong known as the Kowloon Peninsula and the nearby Stonecutters Island were added to the Crown Colony of Hong Kong. In 1898, the New Territories, comprising about 355 square miles of territory north of Hong Kong up to the Chinese border together with 198 adjacent islands and islets, were leased to Great Britain for a period of 99 years. The effect of these additions was to give Hong Kong the total area of 391 square miles it possesses to-day, together with the harbour and the twin cities of Kowloon (on the mainland) and Victoria, across the harbour on Hong Kong Island itself.

Established from the start as a Free Port, Hong Kong rapidly became a centre for the exchange of goods between South China and the rest of the world. This trade was started by British merchant houses in co-operation with Chinese merchants (or compradores), whose descendants are among the most respected members of the population to-day. Associated banking and insurance houses came into being to support the growing trade.

As early as 1843, a dozen large British firms, ten smaller British concerns and a number of Indian firms had established themselves in Hong Kong and the island's first home-built vessel, the "Celestial" of 80 tons, was launched. By the 1860's, ship building and especially ship repairing had become a thriving industry while trade was also expanding rapidly, as Hong Kong became the main port of entry and outlet for the vast South China trading region.

Thus, if somewhat belatedly, Captain Elliot was proved right as Hong Kong revealed its possession of all the features necessary for a great entrepôt port to which the vessels of the world could bring their cargoes for discharge, storage and subsequent transhipment by small vessels to destinations in South China and, in fact, all over the Far East.

Geographically, Hong Kong lies off the south-eastern coast of the Chinese province of Kwantung, east of the Peh (Pearl) River and nearly midway between Singapore and Japan, the former to the south-west and the latter to the north-east.

Lying about 70 miles south of the Tropic of Cancer, and with a large continental land mass to the north and extensive sea areas to the south and south-east, Hong Kong has a monsoon climate. It is therefore liable to be affected by typhoons during the period July to October, although it is not often that a fully developed typhoon passes close enough to Hong Kong to produce winds of hurricane force. The last occasion was in September, 1957.

Hong Kong harbour lies between the island and the mainland and has often been described as sharing with San Francisco and Rio de Janeiro the distinction of being one of the three most beautiful and perfect natural harbours in the world. The harbour varies in width from one to three miles.

Ocean-going vessels generally use the eastern entrance, known as the Lyemun Pass, where a channel of between 500 and 900 yards wide will take vessels up to 36-ft. in draught. The western entrance, though wider, is not so deep, being capable of accommodating only vessels requiring up to 24-ft. of water. On this side, a group of islands, including Tsing Yi, Lantao and Lamma, provide effective shelter.

Within the harbour, vessels can either tie up to buoys or be moored alongside wharves.

There are twelve deep-water berths on the mainland, or northern, side of the harbour and one on the island, or southern, side (Victoria). Of the berths on the mainland, ten belong to the Hong Kong and Kowloon Wharf and Godown Co. Ltd., three of whose installations will accommodate vessels of up to 750-ft. in length and drawing 32-ft. of water. The other two mainland berths belong to Messrs. Alfred Holt and Co. ("Blue Funnel Line"). One is of 470 and the other 450-ft., each with a maximum depth of 35-ft. Three lighter basins alongside the property provide sheltered water for lighter working.

On the Island, North Point Wharves Ltd., incorporated in 1948, possesses the only commercial deep-water berth on that side of the harbour. It has a linear quayage of 1,223-ft., with 30-ft. L.W.O.S.T. Here there is accommodation for two ocean going ships and one coasting vessel.

Altogether, 50 buoys are now in use. Of these, 23 are "A" Class buoys, suitable for vessels up to 600-ft. in length, the remaining 27 being "B" Class buoys for vessels up to 450-ft. The "A" Class buoys include 18 which are graded as typhoon moorings, of which 6 are sited in Kowloon Bay mainly for the use of vessels in dockyard hands. In addition, some 300 private moorings for small craft are in use.

During the financial year 1956-1957, "A" Class moorings were in use for an aggregate of 4,891 days and "B" Class Moorings for 3,920 days.

Older types of mooring blocks are being replaced by 90-ton blocks of modern design and all the "A" Class moorings are now fitted with blocks of this type. Fifty-ton blocks of modern type are now being laid for all "B" Class moorings.

Navigational aids of up-to-date design, which have been installed both within the port and at the entrances, are maintained at an efficient level throughout the year. All lights have been modernised since the re-occupation of the Colony at the close of the Second World War in the Far East.

New electrical equipment on Waglan Island, situated in the open sea off the eastern approaches to the harbour, provides a light which is visible for 21 miles and in addition a diaphone fog signal has been installed. Nearer the actual harbour entrance, on Tathong Point, a powerful electric oscillation is sited. During the

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year ended March 31st, 1957, there were 30 periods of fog at Waglan and Tathong Point with the result that fog signals were sounded for 168 hours 25 minutes at Waglan and 161 hours 35 minutes at Tathong Point.

At the western, and less used entrance to the harbour, an electric light with a range of 16 miles is sited on Green Island, which lies just off the north-west corner of Hong Kong island itself.

Within the harbour, a light marks the Tai Kok Tsui sewage outfall (on the mainland opposite Stonecutters Island), showing a white flashing light of ½ second light, 4½ second eclipse. Light buoys mark the North, Central and Southern Fairways, Lyemun Turning (at the eastern entrance), Bunsansiah and a wreck near Tonku Island.

Ship-to-shore communications are provided by three signal stations operating on a 24-hour basis with modern daylight signal lamps. A radio telephone system at the signal stations on Waglan, Green Island and Blackhead and also in Port Health and Marine launches is linked with the central Control Tower in the Marine Office.

Kowloon Wharves, Hong Kong, showing piers and godowns (warehouses) which are equipped for refrigerated, general, and dangerous cargoes.

During the year 1956-1957, 4,275 inward bound and 4,393 outward bound vessels were reported at Waglan, while harbour signal stations despatched and received 42,709 messages, including 100 emergency signals.

In addition to this ship-to-shore communication, a "Harbourfone" service is available under which vessels, on payment of the appropriate fee, are placed in radio telephone connection with subscribers on shore.

Other port facilties available in the harbour include excellent bunkering, both for coal and fuel oil, stocks of which for commercial bunkering normally approximate to 70,000 tons. Three oil companies have berthing facilities in the harbour and delivery of fuel oil is available up to a rate of 600 tons an hour from the wharf and 350 tons per hour from lighters. Water supplies can be obtained from three different companies, who operate eight water boats between them.

Each entrance is covered by a Quarantine Examination Anchorage with Port Health Officer's launches on duty from 0600—1800 hours daily, an arrangement which speeds the granting of pratique and prevents unnecessary movement of vessels within the crowded harbour. Immigration formalities are also completed in these anchorages so that passengers are free to land as soon as vessels reach their final berth.

Ships are inspected and fumigated as necessary and issued with International Deratting or Deratting Exemption Certificates as appropriate. The Port Health Administration also maintains a constant check on the purity of water supplied to ships through bacteriological examination of weekly samples from water boats and dock hydrants.

Licensed pilots are available to meet vessels at either entrance on request. At the close of the financial year 1957 there were 15 licensed pilots serving the port, three apprentice pilots and three British shipmasters holding pilots' licences.

Administration of the Port

General administration of the port of Hong Kong is in the hands of the Director of Marine, under whose responsibility fall the enforcement of merchant shipping legislation, ship surveys, ship clearances, the collection of light dues, the maintenance of buoys, lights and lighthouses and the operation, maintenance and repair of Government water transport. All port facilities falling outside these categories are provided on a commercial basis by private enterprise.

In the execution of his duties, the Director of Marine is assisted by two Assistant Directors, respectively concerned with port control and ship surveys.

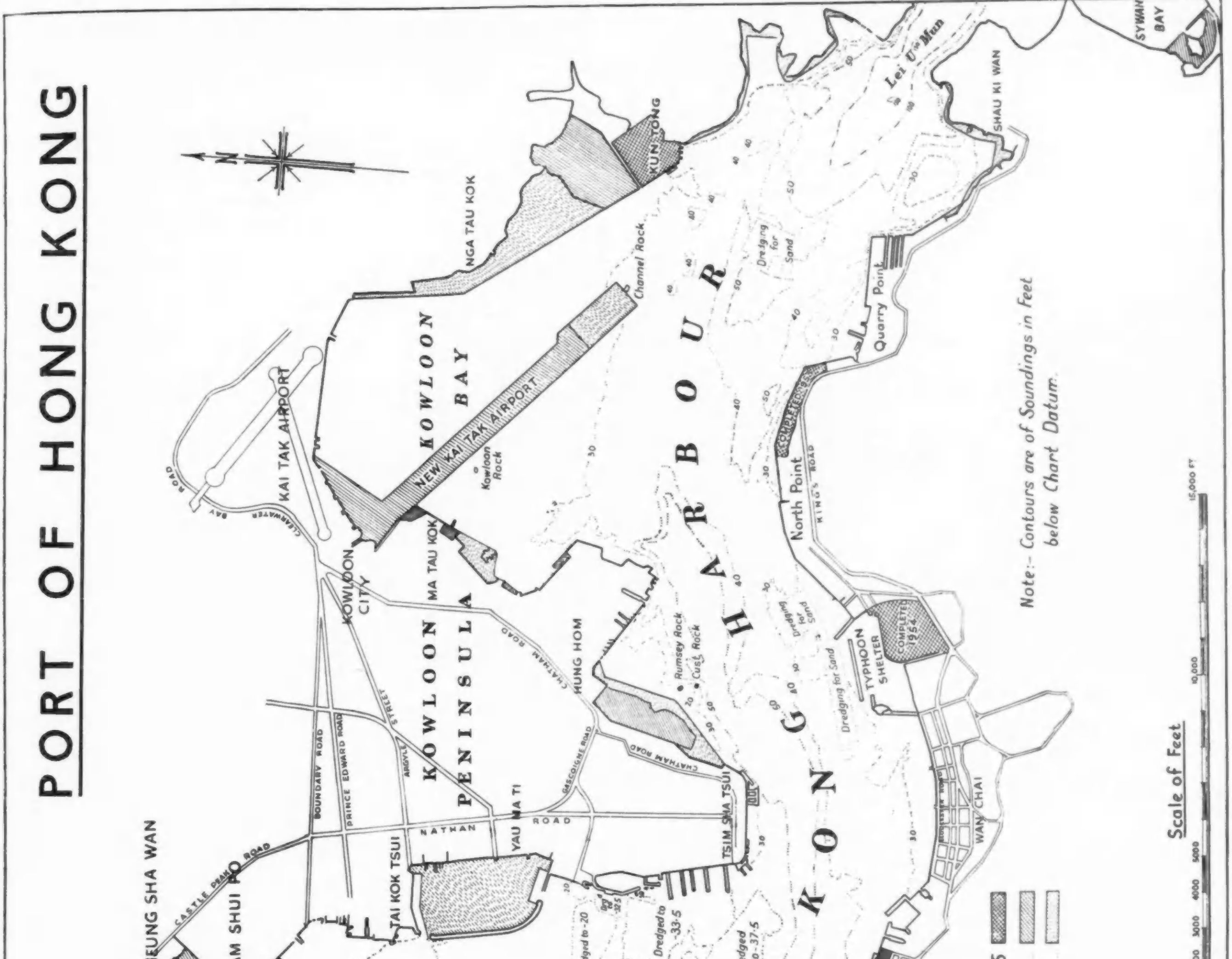
Port Control affairs are further considered under several separate headings. The Port Control Office, for example, is concerned with the entry, berthing and clearance of all vessels in excess of 60 tons net as well as general matters affecting the safety of shipping and the working of the port. The Mercantile Office is responsible for the engagement and discharge of all crews under British Articles of Agreement and all foreign crews who are not otherwise represented by their own Consular Offices.

At the Registry Office, all registry matters concerning vessels on the Hong Kong Register are dealt with. This department also deals with the licensing of the 22,000 junks and other small craft and the entry and clearance of all vessels of less than 60 tons net. The Port Control Branch is completed by the Lights Office, which is responsible for all navigational aids and the Slipway, which deals with some 140 small Government vessels concerned in the service of the port.

In the Ship Surveys Branch a highly qualified staff of officers undertakes surveys on behalf of British and foreign Governments in connection with all classes of international survey duties to the standards of the International Convention for the Safety of Life at Sea. This office, which is maintained on a 24-hour basis, in 1956 carried out such surveys on more than 250 vessels of 12 different nationalities.

To ensure that the administration of the port is in line with the needs and wishes of those using it, a number of committees have been established to advise the Director of Marine on various aspects of port administration. In regard to long-term problems concerned with planning and big construction projects planned by private enterprise, the appropriate advisory body is the Port Committee which sits under the Director of Marine as Chairman and includes among its members four official representatives, the Queen's Harbour Master (representing the Commodore in Charge) and four unofficial members nominated by the Hong Kong General Chamber of Commerce and the Chinese General

The Port of Hong Kong—continued



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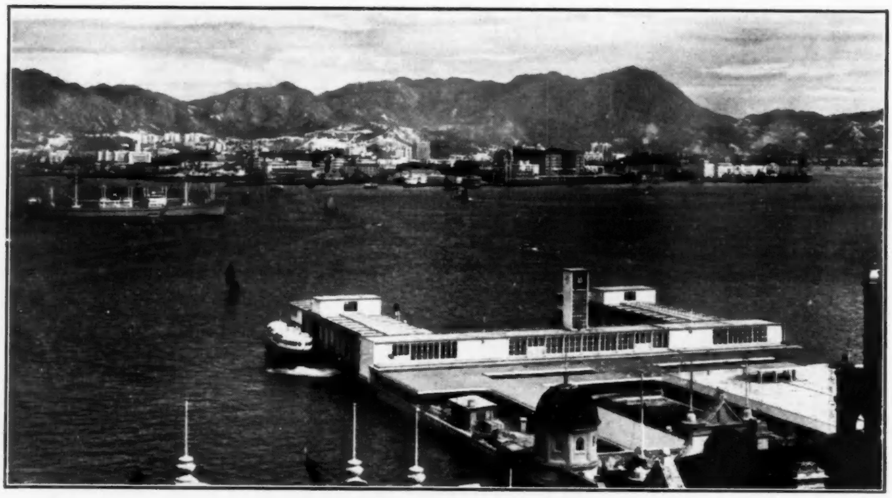
Chamber of Commerce.

Day-to-day problems related to the well-being of the port are discussed by the Port Executive Committee, which represents shipping and warehousing interests with the Director of Marine as ex officio Chairman. The list of advisory committees is completed by the Dangerous Goods Committee, which is concerned with the handling of dangerous cargoes in the harbour and the Port Welfare Committee, which supervises and co-ordinates welfare arrangements for visiting seamen of all nationalities.



Terminal of the Star Ferry. Hong Kong side.

Local Transport Facilities

Because of the presence on each side of the harbour of large centres of population, it is necessary to provide ample means for inter-harbour transport. Most of this traffic is from one side of the harbour to the other, although there is a fair amount of business with certain of the islands in the New Territories. There are two principal marine passenger transport operators who provide ferry services under a public franchise, namely, the Star Ferry Company Ltd. and the Hong Kong and Yaumati Ferry Company Ltd.

Eight passenger-carrying ferries are operated by the Star Ferry Company, whose locally-built vessels of modern design ply between the tip of the Kowloon Peninsula and the main business districts of the island. Operating with a normal frequency of five minutes (three minutes during rush hours), the ferries take about seven minutes to cross the harbour and run from 6 a.m. till 1.30 a.m. Over 36 million passengers were carried during 1957, the average daily load being about 100,000 persons.

Five different ferry services within the harbour limits, including the only trans-harbour vehicular ferry service, the operated by the Hong Kong and Yaumati Ferry Company which also runs six services to outlying districts, particularly during the holiday season. All ferries run according to a time-table, in spite of complex tides and currents and varying winds. The Company's 45 vessels include six vehicular ferries, each capable of carrying 800 passengers and 30 cars. In recent years, the Company has carried about 80 million passengers and approximately 1,250,000 cars annually.

In addition to these two main ferry companies, lighters, motor boats, junks and sampans are also used to convey passengers and goods. A number of companies operate round-the-clock water-taxi services, employing motor boats, which ply to and from vessels at anchor as well as across the harbour.

A proposal for a cross-harbour tunnel and bridge was turned down by the Government in July, 1956.

As befits a harbour which has developed largely on the strength of its unique position as an entrepôt port, with the resultant need to store goods preparatory to breaking bulk for onward transmission to other markets, Hong Kong is unusually well supplied with warehousing facilities (warehouses are known locally as godowns). There are four main wharf and godown companies, as well as about one hundred other godowns separately owned, many of which are modern and highly efficient. As a result, the Colony can offer the shipper and merchant storage capacity which is reliably estimated to be in excess of one million measurement tons.

Of the major concerns, the largest and oldest is the Hong Kong and Kowloon Wharf and Godown Company Ltd., which is situated on the mainland and has storage space for approximately 750,000 measurement tons of cargo. Speedy and efficient handling of incoming and outgoing goods is effected by the Company's fleet of well-found and equipped lighters, with a total capacity of 8,000 tons, for the discharge of vessels at buoys and the transhipment of cargo. On the wharf frontage, the Company maintains a number of electric gantry cranes and other up-to-date cargo-handling equipment.

Modern reinforced concrete godowns are equipped throughout with electric wall cranes, hoists and cargo lifts while a light railway system throughout the Company's property, together with mobile equipment and conveyors, ensures rapid cargo movement.

Godown accommodation in the Company's possession includes a treasure room, facilities for storing dangerous goods and handling timber, logs and other specialised freights. To assist the discharge of general cargoes, ample transit sheds are provided. A discharge rate of 15 tons per gang hour is regularly maintained.

This Company possesses its own efficient fire brigade and security police force. Its labour force is well trained, employed on a permanent basis and available at short notice for duty round the clock.

Holt's Wharf, which is operated mainly for vessels of the Blue Funnel Line and Glen Line Ltd., is also situated on the mainland where storage space in multi-storeyed godowns of brick and reinforced concrete is available for cargo of 45,000 measurement tons. This includes 2,400 tons of bonded space and 7,800 tons of hazardous and extra-hazardous storage.

Cargo handling equipment on this wharf, which is situated near the terminus of the Kowloon-Canton railway, comprises a heavy lift lighter with derrick capacity of 15 tons, four steam gantry cranes of up to 5 tons capacity and mobile cranes and fork-lifts up to $6\frac{1}{2}$ tons.

China Provident Loan and Mortgage Company Ltd., which possesses storage capacity of 175,000 measurement tons, has paid special attention to the storage of chemicals and dangerous goods. Plans are in hand for the installation of a modern, fully-automatic cold store. At present, the Company has 145,000 sq. ft. of storage space, 30,000 sq. ft. of open storage and 30,000 sq. ft. of transit space. Its lighterage fleet consists of 24 units, including four towage vessels.

North Point Wharves Ltd., which is situated on Hong Kong island itself and is a subsidiary of the China Provident and Mortgage Company, has about 60,000 tons of storage and transit capacity, with a further 10,000 tons under consideration. This Company, which possesses the island's only commercial deep water berth, has accommodation for storing liquids with low flash points and dangerous goods, besides possessing cold storage facilities. Special attention is paid to mechanical handling of cargoes and, in particular, heavy or bulky articles.

Shipbuilding and Ship Repairing

It would be natural to expect that from its earliest days a port of Hong Kong's geographical position and economic background would find shipbuilding and ship repairing an important ancil-

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lary to its entrepôt trade activities. In fact, shipbuilding, which has been firmly established in the Colony for well over a century, is still the largest heavy industry.

This activity is largely in the hands of two major concerns, the Hong Kong and Whampoa Dock Co. Ltd., and the Taikoo Dockyard and Engineering Co. of Hong Kong Ltd., which between them possesses new building capacity of 80,000 tons gross. In addition, a number of smaller yards build other craft, such as ferry boats, lighters, yachts and launches.

Since its establishment more than a hundred years ago, the Hong Kong and Whampoa Dock Co. Ltd. has built over 900 vessels ranging from small craft to passenger and cargo vessels of 10,000 tons deadweight. The Company owns and operates five dry docks, the largest of which is 700-ft. in length, as well as extensive berths and wharfage.

All the necessary equipment is available for the construction and repair of ships, whether in dry dock, on slips, alongside wharves or at anchor in the harbour. The Company's vessels include a large tug equipped for deep-sea towing, three other sea-going tugs, an electric welding launch and steam and diesel launches for repairs to vessels at anchor. In an average year, repairs are made to between 700 and 800 vessels, with an aggregate of more than 3 million gross tons.

It was in the spring of 1900 that the firm of John Swire & Sons took the decision to construct a dockyard at the eastern end of the harbour, near the Lyemun Pass, the deep-water entrance to Hong Kong harbour. This was the start of the extensive installations of the Taikoo Dockyard and Engineering Co. of Hong Kong Ltd., which to-day repairs annually about 4 million gross tons of shipping.

With work shops, dry docks, slipways and building berths covering an area of approximately 65 acres, this Company is fully equipped for the building and repair of vessels of all types and sizes. The Company's dry dock is 787-ft. in extreme length with blocks 750-ft. in length and 4-ft. 6-in. high. Width of entrance at top is 93-ft. 4-in. and at bottom 88-ft. 7-in. The depth of the water over the sill, which is in line with the tops of the blocks, is 34-ft. 6-in. at H.W.O.S. Tide.

Dredging and Reclamation Schemes

Although Hong Kong is a natural harbour, the Public Works Department is nevertheless engaged in continuing plans to improve the facilities of the harbour by reclamation and other schemes. A number of these schemes, which are either in progress or projected, can be briefly described to illustrate these points. They may be considered as they affect either the Kowloon (or mainland) side or the Hong Kong (or island) side. They may be further subdivided into works affecting the Eastern or Western halves of the harbour.

Commencing with the Eastern Harbour on the Kowloon side, the most easterly reclamation scheme, in the vicinity of Lyemun Pass, is the natural foreshore between Sam Ka Tsun and Yau Tong Bay, which is to be faced with a pitched slope of angle 1 vertical to $1\frac{1}{2}$ horizontal. Yau Tong Bay itself is to be developed for the shipbuilding industry, with particular reference to junks and smaller craft.

To the west of this section, running from Kun Tong to Ngau Tau Kok, 5,500-ft. of standard section seawall is to be provided giving depth of water alongside the wall from -3.5 C.D. to O—O C.D. A length of this wall has already been completed and reclamation is now in progress. Adjoining this section on the west, a further 3,300-ft. of standard section seawall is planned to give a depth of water alongside of -3.5 C.D. It is possible, however, that a section of this wall will not be built in order not to interfere with the existing shipyards.

In this area of the Eastern Harbour on the Kowloon side the new Kai Tak airport (one of the Colony's major construction schemes) stretches into the harbour to provide a runway 7,200-ft. x 700-ft. which may now be extended to a further 1,750-ft. south eastwards to Channel Rocks.

On the western side of the Kai Tak strip, though still in the Eastern Harbour, a further standard section of seawall running 1,200-ft. south westwards gives a depth alongside varying from -3.5 C.D. to 12.5 C.D. A vehicular ferry pier is to be constructed at the north end and a camber at the southern.

Turning next to the Western Harbour on the Kowloon side, the plans include schemes for the reclamation of the existing typhoon refuge harbour at Yaumati and the completion of seawall of standard section between Cheung Sha Wan and Lai Chi Kok, opposite Stonecutters Island. Final plans are not complete here but present proposals envisage a new typhoon refuge harbour. It has been suggested, however, that such a shelter might be more satisfactory if located further south (i.e. to the west of the existing Yaumati Refuge Harbour).

Finally on this section of the coast, reclamation is taking place in Lai Chi Kok Bay where approximately 1,200-ft. of standard section seawall is to be constructed, giving -3.5 C.D. alongside.

Three reclamation projects are in hand on the Hong Kong shore, including one in the Eastern Harbour where work is proceeding in Aldrich Bay, between Lyemun Pass entrance and the Taikoo Dockyard installation. The work is taking place along the natural foreshore, which will probably be faced with a pitched slope of angle 1 vertical to $1\frac{1}{2}$ horizontal, for possible use as boat building yards.

In the Western Harbour on the Hong Kong side, the Central Reclamation scheme makes provision for the reconstruction of a strip 250-ft. wide from the existing seawall along Victoria Front to West Point. The new construction includes standard section of seawall with depth alongside varying from -3.5 C.D. to -14.00 C.D.

Further west still, in the vicinity of Green Island, the Kennedy Town Reclamation envisages the extension westwards of the existing seawall for a further 1,400-ft. to permit the siting of the New Abattoir and a public swimming pool. Here again there will be seawall of standard section giving -3.5 C.D. alongside.

The recently constructed cross-harbour Star Ferry Pier showing new car park with three-tiered car parking lots.

These reconstruction plans are designed to enable the port of Hong Kong to maintain its position among the leading harbours of the world, in spite of the changing conditions under which it operates. Until 1939, Hong Kong remained predominantly an entrepôt port, it being estimated that probably 75% of the total

The Port of Hong Kong—continued

trade of the port was then concerned with goods moving through on their way to or from China. Since the war, however, the unsettled conditions in China itself, culminating in the emergence of a Communist regime and the imposition of controls on trade by those on both sides of the frontier have resulted in a marked reduction in the part which Chinese trade now plays in the Hong Kong economy.

Instead, Hong Kong has developed partly into a distributing centre for other Far Eastern countries and, more significantly, into an exporter of its own products and an importer of the necessary raw materials for their manufacture. Although the industrial development of Hong Kong falls outside the scope of this survey, it may perhaps be of interest to point out that in 1956, exports of Hong Kong products (in millions of Hong Kong

Discharging cargo at Port of Hong Kong.

dollars) included cotton piecegoods (173.3), cotton yarn (97.6), footwear (76.7), household utensils of iron and steel, enamelled (76.2), cotton singlets (75.5) and shirts (71.6). Among many other exports may be mentioned such articles as electric torches, plastic articles, batteries and vacuum flasks.

Japan and many other countries have set up special sales agencies in Hong Kong, finding that the island provides on a world scale all the services of a wholesale merchant. Here are available expert buying facilities, cheap and plentiful finance, excellent storage, shipping and insurance facilities, banking and other commercial services and ability to break bulk. Above all, of course, there is the service of an excellent port and harbour with all the necessary ancillary services.

During the financial year 1956-1957, a total of 7,650 ocean-going ships entered and cleared Hong Kong, amounting to 21,981,848 nett tons. This was a decrease of 220 vessels (2.79 per cent.) but an increase in nett tonnage of 174,258 tons (0.79 per cent.) compared with the previous year.

Cargo discharged totalled 3,571,332 tons weight and cargo loaded amounted to 1,751,092 tons weight. Both these represented increases over the preceding year, cargo discharged rising by 4.15 per cent. and cargo loaded by 7.54 per cent. Cargoes carried by junks and launches rose considerably, the total discharged (1,103,679 tons) being an increase of 41 per cent. and the quantity loaded (118,283 tons), an increase of 59 per cent.

With the general slackening in world trade and the rising tonnages of laid up shipping capacity, it is inevitable that Hong Kong will experience during the current year a falling off in shipping activity. On the other hand, Hong Kong authorities point out that in any case the Colony is now far less dependent on the entrepôt trade than formerly and that the island's growing industrial production exerts a rising demand on shipping space and port facilities. Above all, the port serves a world region whose biggest potential expansion lies in the future. It is thus clear that the excellent facilities offered by the port will, in years to come continue to reap the due reward of efficiency.

Correspondence

To the Editor of "The Dock and Harbour Authority."

Littoral Sand Movement at Abidjan

Sir,—I have been interested in the reports on improvement at the Port of Abidjan which appeared in the March and June, 1958, issues of "The Dock and Harbour Authority." I am somewhat puzzled by the discussion of littoral drift in the latter issue, particularly these statements:

"The effect of all these factors is to produce a west to east littoral drift of sand estimated at about one million tons per annum. It is therefore surprising to receive a report that a new sand beach is forming to the west of the west breakwater accompanied by significant erosion of the beach to the east of the canal."

Unless the directions were inadvertently stated in reverse in one case or the other there would appear to be nothing unusual in the observed behaviour of the shores. I should appreciate learning in which instance the error, if any, occurred.

Along the coast of Liberia the predominant direction of littoral drift is northwestward at a rate, measured by accretion southeasterly of the south breakwater at the Port of Monrovia and erosion of shores to the northwest, of 500,000 cubic yards per annum. The Guinea Current is also present along this coast but it appears that its influence with respect to littoral drift is negligible as compared with wave energy directed from the southern and southeastern quadrants. The general east-west alignment of the Ivory and Gold Coasts should be nearer to normal to the resultant of the wave energy pattern, suggesting a somewhat smaller net drift rate than that along the Liberian Coast. With no other evidence available, I should have considered it possible that the prodominant littoral drift direction at Abidjan could be east to west.

With respect to siting of the Vridi Canal in proximity to the deep geological rift in the African Continental Shelf, it would appear that the seaward end of the west breakwater, founded at a depth of approximately 50-ft., is perched on the bank of the rift. There are three harbours on the Californian Coast similarly sited at the heads of submarine canyons namely Moss Landing in Monterey Bay, Port Hueneme, and Redondo Harbour. The last of these was completed too recently to afford any shoaling data but in the case of the first two it appears that the updrift breakwater in each case diverts littoral drift into the submarine canyon with only a negligible quantity passing the structure to lodge in the channel. At another California site, Newport Harbour, the continental shelf is quite narrow and it was possible, without excessive cost, to found the seaward end of the updrift breakwater on the edge of the shelf at 55-ft. depth. There has been no shoaling in the inlet channel in the 22 years since it was completed. The updrift shore shows no evidence of accretion indicating that littoral material is being diverted to the precipitous slope of the continental shelf.

In each of the inlet channels described above the tidal prisms are relatively small and bottom current velocities probably are never as high as 2-ft. per second. Constricting works to create scouring velocities were intentionally omitted and are considered to be not required when shoaling sediment can be prevented from entering the channel. For the site conditions as described for the Vridi Canal I am inclined to wonder whether the scour resistant sill is a necessary feature. I hope you will find it possible to publish additional data on this project which may aid in clarifying the matter.

Corps of Engineers, U.S. Army,
Beach Erosion Board,
Washington, D.C.
4th September, 1958.

Sincerely yours,
R. O. EATON,
Chief Technical Advisor.

[The Supplementary Note in our June, 1958, issue was based upon correspondence received from Abidjan. Mr. W. J. Reid has stated in our July correspondence that the accumulation of sand to the west of the West Breakwater of the Vridi Canal is a natural result of the littoral drift from west to east; the drift has been estimated at about one million tons pre year. We are indebted to Mr. Eaton for additional information he gives here regarding the direction of the littoral drift at the Port of Monrovia, and the success of inlet channels without constricted mouths at harbours on the Californian Coast.—ED.]

Modern Dry Docks: Design, Construction and Equipment

X. The Legal Aspects of Dock Construction

(Specially Contributed)

THE scope of existing or proposed statutory requirements relating to safety, health and welfare in dock construction and maintenance is a wide one. In this article it is possible only to indicate the range of risks which are covered and the types of remedies which should be applied. It must be pointed out, however, that the official prescription for accident prevention is, in many cases, quite detailed, and it is therefore necessary for those engaged in carrying out the work and having legal obligations in the matter of compliance to study carefully the detailed requirements in the official documents.

Definition of Statutory Requirements

The construction of a dock, in so far as it is the subject of legal requirements, is not distinguished from a number of other specified works of a civil engineering character which are designated for legal purposes, under the generic term "work of engineering construction." This term has its origin in the Factories Act, 1937, where it is legally defined for the purpose of specifying certain classes of work to which particular requirements of the Act apply. The Act also bestows upon the Minister of Labour and National Service power to make special regulations containing requirements for safety and health where he is satisfied that there is risk of bodily injury to persons employed.

"Work of Engineering Construction" is defined in Section 152(1) of the Factories Act, 1937, as meaning "the construction of any railway line or siding otherwise than upon an existing railway, and the construction, structural alteration or repair (including re-pointing and repainting) or the demolition of any dock, harbour, inland navigation, tunnel, bridge, viaduct, aqueduct, sewer, sewage works or gas holder except where carried on upon a railway or tramway, and shall include such works as may be specified by regulations of the Minister."

For the purposes of the above definition the terms "railway" and "tramway" have restricted meanings, the former meaning any railway used for the purposes of public traffic whether passenger, goods or other traffic and including any works of the railway company connected with the railway; "tramway" means a tramway authorised by or under any Act of Parliament and used for the purpose of public traffic. Any such railway or tramway or any of the named types of work carried on upon such a railway or tramway does not therefore fall within the scope of the definition of "work of engineering construction."

Another definition which also appears in Section 152(1) and which may require consideration in connection with dock work is that referring to a "building operation." A "building operation" means the construction, structural alteration, repair or maintenance of a building (including re-pointing, redecoration and external cleaning of the structure), the demolition of a building and the preparation for, and laying the foundation of, an intended building but does not include any operation which is a work of engineering construction.

The term "building" is not defined and an interpretation of what constitutes a building is a matter for determination by a Court in any particular case. It will be noted, however, that the two definitions are virtually complementary to the extent that work on any structure might be held to be a building operation so long as the structure is not one of those defined as a work of engineering construction. The fact that a work of engineering construction is specifically excluded from the definition of "building operation" leaves it to be inferred that the term "building" should not be interpreted too narrowly. It should also be noted that the Minister of Labour and National Service is empowered to extend the definition of "work of engineering construction" to include such other works as he may specify. Up to the present, however, the Minister has not availed himself of those powers.

The effect of these complementary definitions in relation to constructional and such like operations at dry docks may well be either to extend the relevant requirements of the Factories Act to work which does not constitute part of the dock or, alternatively, to make such other work subject to requirements other than those which apply to the dock. For example, the construction of a pump house on a dock is no doubt a building operation, while the construction of a pipe line or bridge may be subject to requirements specifically applied to those classes of work rather than to requirements applicable to the dock to which their construction is incidental.

The range of work embraced by a "building operation" or by a "work of engineering construction" may be subject to requirements imposed either by the Act itself or by order or regulation or by a code of special regulations. So far as the Act is concerned the requirements relating to building operations and works of engineering constructions are virtually similar except for a saving clause to the effect that, in the case of a work of engineering construction, the powers of a Court to make an order as to dangerous conditions and practices or any requirement of special regulations shall not operate so as to interfere with the design of the works or with the adoption of a method prescribed in the specification or in any signed plans issued or directions given by a consulting engineer or the engineer-in-charge, provided also that such a method is not inconsistent with the safety of the works or of the persons employed.

Obligations of the Factories Act

The obligations imposed by the Factories Act upon a person undertaking either a building operation or a work of engineering construction apply where the operation or work is carried on by way of trade or business or for the purpose of any industrial or commercial undertaking, and to any line or siding used in connection therewith which is not part of a railway or tramway. Operations or works falling within the scope of the definitions and carried out by or on behalf of the Crown or any municipal or public authority are not exempt, even though the work is not being done by way of trade or for the purpose of gain. In all such cases it is the responsibility of the person undertaking the work to notify H.M. Inspector of Factories for the District within seven days of its commencement, unless either the work or operation is expected to be completed within six weeks or it is a work or operation already in progress of which notice has already been sent.

Other obligations cover the provision of sufficient and suitable sanitary conveniences, periodical examinations and other safety precautions for steam boilers and air receivers, medical examination of young persons, affixing of statutory notices and the keeping of registers. In addition, persons employed on such works or operations are required to use, and are prohibited from wilfully interfering with or misusing any means, appliance, convenience of other statutory provision made for securing the health, safety or welfare of persons employed. The Act forbids any person employed from wilfully and without reasonable cause doing anything likely to endanger himself or other persons.

Special Regulations for Docks

Specific requirements for safety, health and welfare on constructional work connected with docks are generally provided for by means of special regulations made under the special procedure laid down in the Factories Act. Notification of a proposal to make regulations is given in the "London Gazette" and by other

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suitable means for the purpose of informing persons likely to be affected by the proposed regulations, copies of which can then be obtained. Persons likely to be affected may then, if they think fit, raise objection to the draft regulations and if, in consequence, the draft is amended having regard to the objections a revised draft is issued and the same procedure followed as with the original draft. Ultimately, if all relevant objections made on behalf of the majority of the persons likely to be affected are met or withdrawn the Regulations can be given force of law and then become a statutory document; otherwise, if the objections are not met or withdrawn a public inquiry is held following which appropriate regulations may be given legal force.

In the Factories Act itself only a very few of the many detailed requirements apply to building operations and works of engineering construction, and likewise although many codes of special regulations have been made very few have any application to constructional work at docks. Nevertheless, four codes of Special Regulations may apply to such work. These are the Building (Safety, Health and Welfare) Regulations, 1948, the Work in Compressed Air Special Regulations, 1958, the Electricity (Factories Act) Special Regulations, 1908 and 1944, and the Woodworking Machinery Special Regulations, 1922 to 1945. The Building Regulations will only apply if work is being done in connection with a building (not being a structure covered by the definition of a "work of engineering construction"), while the respective other three codes apply where work is being carried on in compressed air, where electricity is used and where certain machines which are defined in the regulations as "woodworking machines" are used. The Building Regulations specify precautions which have to be observed regarding scaffolding, ladders, lifting appliances, chains, ropes and lifting gear, hoists, hoisting of loads, excavation work, demolition, first aid, shelters, clothing and washing accommodation and facilities for meals, eye protection, preventing inhalation of dust or fumes, guarding of machinery, use of vehicles, explosives, lighting, prevention of drowning and a number of other miscellaneous precautions.

A preliminary draft code of regulations dealing with safety, health and welfare in connection with work of engineering construction was first issued in 1945 and later, in 1951, a revised preliminary draft was published. This revised draft was issued as a reprint by H.M. Stationery Office in 1958, but in this latest edition the precautions proposed for work in compressed air have been omitted since these, suitably amended after submission to the formal procedure for the making of special regulations, have now assumed legal force by the making of the Work in Compressed Air Special Regulations already mentioned.

Although certain constructional operations in connection with docks may fall within the scope of the Building (Safety, Health and Welfare) Regulations, most constructional work on docks is covered by the applications clause of the revised preliminary draft for work of engineering construction. This draft follows the same general lines as the Building Regulations but some of the proposals are less detailed. For example, scaffolding used on building operations is the subject of 29 regulations, whereas only 23 clauses in the draft for work of engineering construction relate to scaffolding. Nevertheless, the range of operations covered by the revised preliminary draft is much wider, covering not only precautions somewhat similar to those in force for building operations, but also precautions for work in shafts and tunnels, in connection with cofferdams and caissons, for diving operations, concerning the purity of the atmosphere in confined places and for work on or adjacent to water. Some sections are more detailed, for example, the use of explosives is the subject of five paragraphs in the revised preliminary draft compared with one paragraph in the Building Regulations. Altogether, the draft contains 152 clauses compared with 100 in the Building Regulations.

Responsibility of Employers

The Factories Act places the general duty of complying with the law upon the occupier of the premises, and in the case of a building operation or work of engineering construction this means the person or persons undertaking such work. In the various codes of regulations, however, responsibility for compliance may extend to occupiers and other classes of persons. In the case of the Building Regulations the duty of complying with particular requirements is variously imposed on contractors and employers of workmen dependent on whether their workmen are affected, or on whether they are performing a particular work, act or operation or on whether they erect or alter a scaffold or erect, instal, work or use a crane, machine, appliance or plant and in addition to the general duty already referred to which is placed upon persons employed under the Act, all the codes of regulations applicable place duties upon persons employed to ensure their co-operation in carrying out the requirements. In the draft proposals for work of engineering construction duties are imposed on very similar lines.

The prime purpose of these codes of regulations is to secure the safety, health and welfare of those concerned in the work or operation, and while this is a statutory duty in the particular cases where the requirements apply, there is little justification for failing to observe the standards laid down, even where they may not be legally enforceable bearing in mind the consultative procedure which precedes the making of regulations. The temporary character of the operations and especially the constantly changing plant layouts make it essential that statutory standards should become the routine method of working if only to ensure that legal obligations are complied with where they do apply, and quite apart from the reduced risks of injury to body or health if safe practices are followed.

Safety Precautions to be Observed

Basically, safety on constructional work at docks depends on the observance of four principles. Firstly, provision of an adequate amount of plant and equipment to enable persons employed to reach without undue risk every place at which work has to be done. Secondly, all plant and equipment used should be of good construction, of suitable and sound material, of adequate strength for the purpose for which it is used and free from defect; in addition, it should be provided with all the necessary safeguards to prevent danger to persons connected in its use or working in proximity to it. Thirdly, all plant and equipment should be maintained in a sound and safe condition and if any defects develop, it should be withdrawn from use and rendered either unusable or inaccessible until it has been properly repaired. Lastly, the plant and equipment provided should be used only for the purposes for which it is intended and all the due precautions connected with its use should be observed.

Plant and equipment to enable persons to reach their places of work involves the provision of scaffolding, ladders and the like. Apart from the soundness of the equipment, it must be properly assembled, effectively secured, not overloaded and regularly examined. The use of improvised equipment such as ladders with unnotched rungs and platforms or gangways supported on loose bricks should be prohibited. Since the provision of scaffolding is generally to enable work to be done at heights safeguards are necessary to prevent men falling from the scaffold or material falling on persons at a lower level. There must be toe boards and guard rails at proper heights and intervals, and platforms should be close boarded and sufficiently wide for the purposes for which they are used. Guard rails should always be in position except where the circumstances of the work make removal imperative and there is no practicable alternative safeguard; and they must be reinstated immediately when the need for their removal no longer exists. A ladder should never be used unless, either it is so secured that it cannot move from its top or bottom points of rest, or there is a person stationed at its base to prevent slipping. It is generally practicable to secure a ladder near the top, but one person should be stationed at the bottom while another ascends to make the fixing. Risk of falling arises not only from temporary plant such as scaffolds and ladders, but also from corners, breaks or edges of permanent structures and through openings in floors or roofs and even in walls, and precautions by the provision of guard rails and toe boards are necessary in such cases. Where openings are temporarily covered over, the arrangements should preclude the possibility of the cover being accidentally displaced and there should be a warning notice that the cover conceals a dangerous

Modern Dry Docks—continued

opening. The risk of accidental displacement arises with many temporary structures or arrangements, for example, scaffold boards forming a platform, and fixings to prevent the possibility should always be provided.

Lifting Appliances

Lifting appliances, by which is meant, machines or appliances used for raising and lowering loads of material or personnel, create dangers not only for those actually using them, but also forothers in the vicinity. The consequences of a crane collapse, for example, may be very far reaching, whether the cause be overloading, poor design, structural or mechanical defects, or insecure support or anchorage. The precautions necessary to ensure safe working are even more important in the case of a temporary installation than in the case of permanent plant. The rail tracks on an inadequately prepared foundation or soft or uneven ground may seriously reduce the stability of a rail mounted or runabout crane, or a hurriedly made anchorage lashing to secure a pulley block may be overstressed in one of its returns. Danger to persons unconnected with the use of a lifting appliance may arise from causes not associated with the raising of a load as, for example, the running down of a person by a mobile crane, or crushing against a fixed object by the tail end of a slewing crane. Day to day inspection and maintenance are of the utmost importance to ensure, for example, efficient braking or good conditions of ropes, and here the competence of the driver or operator is paramount in order to ensure that unsafe conditions do not arise through inefficiency. The operator, however, must be given every assistance in the way of protection from the weather with good visibility, an efficient signalling system, marking of control levers, indication of safe working loads, and weight markings on loads to be lifted. So far as possible, mechanical arrangements and controls should be automatically safe so that, in the event of failure of the human element, dangerous conditions shall not arise. A case in point is the interlocking arrangement between the derricking clutch and the pawl sustaining the derricking drum on jib cranes which, if properly designed and effectively maintained, automatically prevents the driver inadvertently losing control over the descent of the jib. Automatic cut-outs to prevent overloading come within the same category.

Handling Equipment

Chains, ropes and their end fittings and gear for the attachment of loads can be a source of danger in the handling of loads unless they are of good design, adequate strength, properly maintained and used in a manner whereby they are not subjected to stresses for which they are not designed. Frequent examination to detect deterioration is most important. Chafing, brittleness and exposure to acids or fumes are particularly damaging to fibre ropes, while kinking and evidence of broken wires should cause consideration of the continued use of a wire rope. Chains and other metal fittings should regularly undergo heat treatment appropriate for the particular material. Equipment of this kind should never be improvised. For example, site forming of hooks from round bar is a dangerous proceeding. Safe design whereby a hook is of such a shape as to prevent accidental release of the load is of almost equal importance to adequate strength. Correct usage is vital. Allowance should be made in choosing a multiple sling to lift a load for the increased stress due to the angle between the legs. More than one end fitting should never be accommodated in the bight of a hook which would otherwise tend to open out.

Hoists comprising a carriage, platform or cage moving vertically in guides require expert installation and maintenance to ensure safe working. Periodic extensions of the hoistway as work progresses necessitate careful resetting of the overrunning devices and safety gear. In addition to protective gates and enclosure to prevent persons falling down the hoistway or being struck by the hoist at landings, including access to the hoistway at its lowest position, other points to which access to within reach of the moving platform may be gained, for example, by workmen on ladders, should be protected. Hoists should only be capable of being operated from one position at any one time and if used for carrying passengers the operating controls should be located in the cage. Under certain circumstances it may be necessary to raise or lower persons otherwise than in a hoist cage and, subject to conditions, this is permissible in the case of certain types of equipment constructed and operated in a manner to ensure the safety of the persons being raised or lowered. Precautions are also necessary when loose objects or materials are being raised or lowered, either by securing them against risk of displacement, or by using a container sufficiently enclosed to prevent them falling.

Excavations

Excavations involve three types of risk, namely, falls of material from sides or roof, falls over the edge of a trench or other open excavation and asphyxiation or gassing in a shaft or tunnel due to shortage of oxygen, the presence of poisonous gases in the ground or the generation of toxic fumes by an internal combustion engine, by a welding process or by the use of explosives. Collapse of the walls or roof of an excavation may be unanticipated and inconsistent with the nature of the strata, for which reason timbering or strutting is often overlooked or considered unnecessary. Risk of collapse is often increased by earlier excavation work which is no longer obvious, by structures with shallow foundations, and by material stacked or traffic movement near the edge. A shallow trench will not obviate risk of being buried if collapse occurs as a person may be stooping or be brought down by the falling earth. Four feet is considered the maximum depth at which timbering may be dispensed with. Persons erecting timbering are not immune from the danger of burial and should so conduct their work that they are within the protection of timbering already in position while erecting fresh timbering. The means of providing protection for timbermen should not be left to their discretion, and the system of working should be organised to ensure that at no time is anyone allowed to be in a position where a fall may occur and bury him. Where an excavation is of substantial depth protection is necessary to prevent materials or tools falling on to persons below. This is particularly important in vertical shafts where the necessary protection can be provided by means of diaphragms in which the openings for the passage of men and raising and lowering of materials should be as small as possible. Apart from the provision of adequate means of access to and egress from excavations, the possibility of the need for escape in cases of emergency, for example, flooding, should not be overlooked. Risk of gassing or asphyxiation should be dealt with by the admission of an adequate supply of fresh air and the removal of toxic fumes by exhaust ventilation applied as near as possible to the source of generation so that pollution of the general atmosphere is prevented. Initial and routine tests of the atmosphere may be necessary to confirm that workplaces are free from the danger of a person being overcome by poisoning or asphyxiation. In such places where there is a possibility of the atmosphere being dangerous, breathing apparatus and rescue equipment should be provided. Precautions to prevent risk of explosion by flame or other open lights should be taken where inflammable gases are liable to be present in the atmosphere.

Cofferdams and Caissons

Work in cofferdams and caissons gives rise to most of the risks mentioned in connection with excavations. In cofferdams as in excavations the effectiveness of the protective walling requires to be frequently checked, and this is particularly important where blasting is done. In caisson work, the requirements of the Work in Compressed Air Special Regulations, will generally apply, and strict compliance with them is necessary to avoid injury to the health of men working in an atmosphere where the pressure is in excess of atmospheric pressure. Medical examinations of persons entering compressed air workings and rules for compression and decompression are laid down with tables specifying minimum times and maximum rates for decompression, according to the amount of pressure in the working chamber and the duration of the period of exposure. The requirements cover purity of the air supply, control of humidity, standards for the compressor

Modern Dry Docks - *continued*

plant, essential fittings and controls for air locks, the provision of a medical lock and certain welfare requirements.

Diving Operations

These "Compressed Air" Regulations do not apply to diving, an operation which may frequently have to be resorted to in dock maintenance work. Diving operations have not, however, been overlooked and precautions for these are included in the preliminary draft of Work of Engineering Construction Regulations. These proposals with respect to diving are not so detailed as for compressed air work, it apparently being considered that so long as proper equipment and attendance is available, a man who has had the necessary training to undertake diving work is competent to decide how he shall carry out his work. Medical examination is, however, essential to ensure that he is in a fit state of health for the work. However, these proposals for diving operations scarcely differ from the proposals originally published in 1945. Since then there have been developments in diving technique, including the advent of frogmen to civil engineering operations. It may be that the requirements for diving may differ appreciably from the revised preliminary draft before they are given the force of law.

Explosives and Demolitions

The use of explosives for blasing purposes is attended with considerable risk unless the work is carried out by experienced workers under the control of a trained foreman fully conversant with the risks and keen to enforce all the necessary precautions. Transport and storage of explosives should be in accordance with the requirements of the Explosives Acts, and proper records should be kept showing in detail the quantities of explosives received, issued and used, with particulars of misfires and return to store of explosives not used. Precautions are necessary to prevent accidental ignition by open light or flame or otherwise, and adequate warning with provision to enable persons to take shelter from flying fragments should be given before charges are fired.

Safety in demolition work is mainly dependent on the employment of competent supervisors and experienced workmen who can be relied on to appreciate the risks arising from the work, and to take the necessary precautions. Care is also necessary to avoid danger from services, such as electricity, gas or water supplies, or from structures which may be affected by the demolition operations.

General Precautions

Work carried out adjacent to or over water where there is a risk of drowning must have arrangements for the rescue of persons who may fall into the water. If there is special risk of a person falling into the water from the edge of places to which there is likely or ready access, the provision of fencing should be considered.

The use of transport, including locomotives, trucks, wagons, or other vehicles, whether on rails or as runabouts, is the subject of precautions. Drivers must be over 18 years of age, have been properly trained and competent. Rail tracks and equipment for the movement of vehicles must be properly maintained and there must be adequate clearances to prevent trapping between vehicles in motion and other objects close to the track. Brakes, sprags or scotches have to be provided as appropriate and proper warning of movements of vehicles has to be given to prevent danger being caused by the movement. Persons carried on vehicles must be in a safe position and precautions are necessary to prevent vehicles used for tipping from falling over the edge of the tip.

Other miscellaneous precautions which have to be taken include the guarding of machinery, protection for the eyes and prevention of dangerous dusts or fumes being inhaled. Working places have to be adequately lighted, overhead protection is required for places where persons are habitually employed and liable to be struck by falling objects or material. Loose materials, and particularly timber with projecting nails, have to be removed from places where persons are liable to fall over or tread upon them.

The provision of first-aid and, in certain cases, ambulance arrangements, is required and facilities for shelter from the weather, washing the hands and taking meals are also necessary, along with accommodation for clothing not worn during working hours and for protective clothing. Finally, a suitable and qualified person is required to give attention to safety matters and to see that the work is generally conducted in a safe manner.

The risks and corresponding precautions mentioned in this article are solely related to the work of construction and maintenance without reference to the subsequent use to be made of the work. Those who use docks, however, have also statutory obligations to fulfil, and some of those can most effectively be met by provision made at the design or construction stage. For example, a preliminary draft of a new code for the revision of the Shipbuilding and Ship-repairing Regulations has just been published in which there are requirements affecting the structure of a dry dock with which the person ultimately using the dock will have to comply. These include the provision of hand rails for flights of steps, fencing for edges of altars and for the edges of the dock at ground level. Similarly, under the Dock Regulations, 1934, there is an obligation with persons having the general management of docks, wharves and quays in use for the loading and unloading of ships to fence breaks, dangerous corners and edges of docks, and to provide means, e.g., ladders, to enable persons who may fall into the water to escape therefrom. Although responsibility for complying with these requirements does not rest with the person constructing the dock, it is obviously desirable that provision for such fencing should be made in the design of the dock so that the user can, without further structural work, comply with his legal obligations.

Cathodic Protection of a Vessel Operating in Polluted Estuarine Waters

By D. S. TULLOCH, B.Sc.

The vessel concerned in this article is the "J. H. Hunter," a sludge disposal vessel owned by the L.C.C. and operating between the Northern or Southern London Sewage Outfalls and the Black Deep at the mouth of the Thames Estuary. The ship is of 260-ft. L.O.A., 48-ft. beam, 15-ft. draft and her wetted area is approximately 16,000-ft.[2]

The vessel's service is arduous; she operates in notoriously corrosive waters, also, whilst alongside the outfall jetties, she not infrequently rests in muds rich in sulphate reducing bacteria.

In 1955 it was agreed to fit the vessel with a small-scale cathodic protection installation to determine the effectiveness of this method in preventing corrosion wastage of the hull in polluted

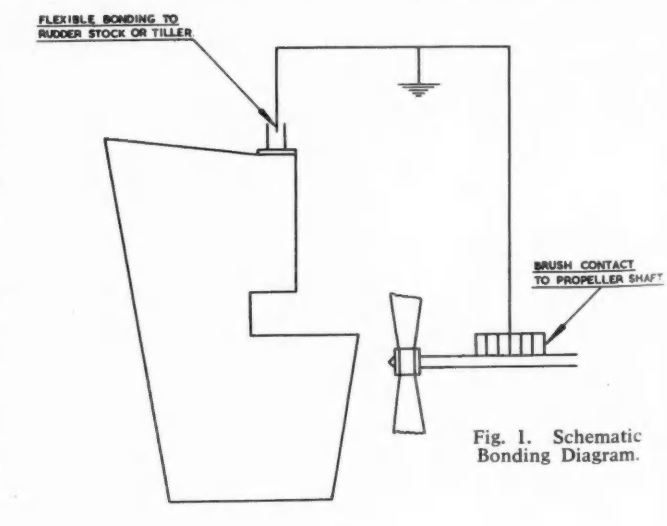
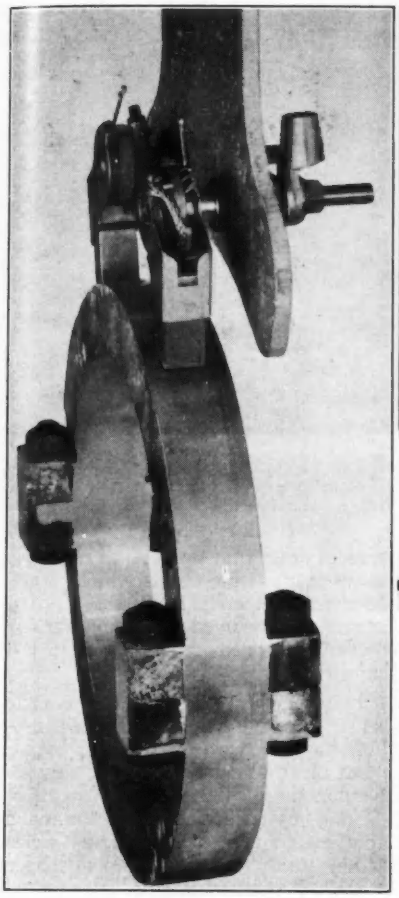


Fig. 1. Schematic Bonding Diagram.

Cathodic Protection of a Vessel—continued



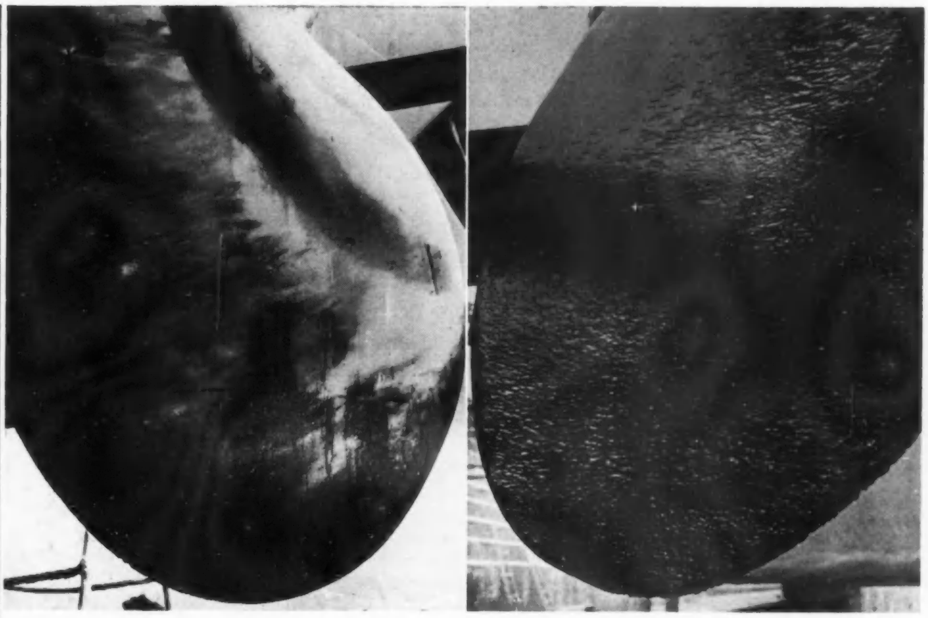
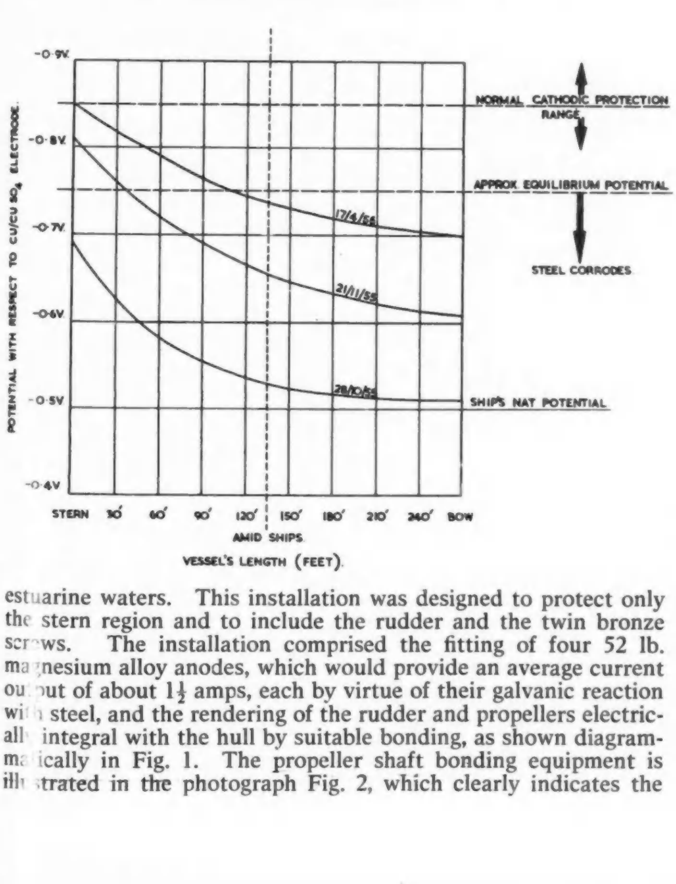


Fig. 2 (left). Showing brass slip ring and phosphor bronze sliding contactors for propeller shaft bonding. Fig. 3 (below). Graph showing measurements from the small-scale installation. Fig. 4 (above). Showing, on left, port propeller with one year's cathodic protection, and on right, starboard propeller — one year without protection.



estuarine waters. This installation was designed to protect only the stern region and to include the rudder and the twin bronze screws. The installation comprised the fitting of four 52 lb. magnesium alloy anodes, which would provide an average current output of about $1\frac{1}{2}$ amps, each by virtue of their galvanic reaction with steel, and the rendering of the rudder and propellers electrically integral with the hull by suitable bonding, as shown diagrammatically in Fig. 1. The propeller shaft bonding equipment is illustrated in the photograph Fig. 2, which clearly indicates the brass "slip-ring" which clamps to the propeller shaft and the sliding spring loaded phosphor bronze contactors on their mounting plate.

Immediately following the installation, which took place in October 1955, potential measurements were taken, using a corrosion voltmeter and $Cu/CuSO_4$ half-cell, to determine the effectiveness of the installation, and during the vessel's operational year a check was kept upon the degree of protection maintained. The effectiveness of the propeller and rudder bonding arrangements was determined whilst the propellers were revolving and the ship under way soon after the installation and the results are given below:

1. **Port Propeller**
   (a) Bond connection open circuit—Potential difference hull-shaft 145 mV.
   (b) Bond connection closed circuit—Potential difference hull-shaft Nil.
   Bond satisfactory.
2. **Starboard Propeller**
   (a) Bond connection open circuit—Potential difference hull-shaft Nil.
   (b) Bond connection closed circuit—Potential difference hull-shaft Nil.
   Bond satisfactory.
3. **Rudder**
   (a) Bond connection open circuit—Potential difference rudder-hull 10 mV.
   (b) Bond connection closed circuit—Potential difference rudder-hull Nil.
   Bond satisfactory.

The degree of protection achieved by a cathodic protection installation is most satisfactorily determined by potential measurements. In cathodic protection the subject so protected is made the cathode of an electrolytic cell the other electrode being the applied magnesium, or other, anode. The cathode potential is thus shifted or "swung" in the negative sense from its original or natural value to a degree dependent upon the parameters of the cell. Potentials are usually measured relative to a constant potential reference electrode and such an electrode is the $Cu/CuSO_4$ half-cell. The "natural" potential of steel, in sea or brackish water, taken with respect to a $Cu/CuSO_4$ electrode is usually between .5 and .6 volts negative. Cathodic Protection is acknowledged to be achieved when the potential of steel has been

Cathodic Protection of a Vessel—continued

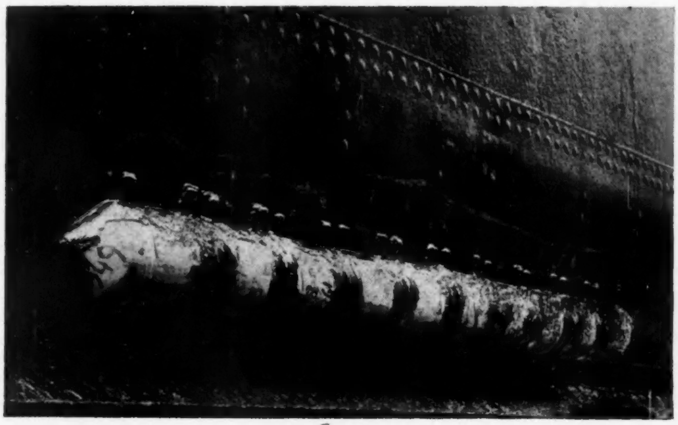


Fig. 5. Midship anode group of full installation fitted 1956.

Fig. 7. Midship anode group of the full installation after one year of service.

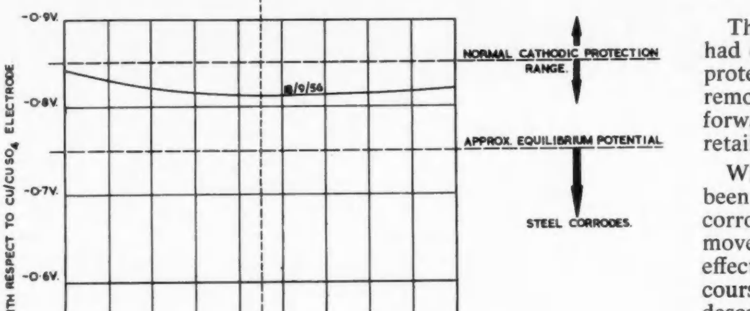


Fig. 6. Full-scale Installation.

swung to between .80 and .85 volts negative with respect to the same class of electrode.

In Fig. 3 are given three potential curves for the "J. H. Hunter" taken over a period of seven months following the installation and showing the build up of protection with time, and also illustrating the effectiveness of the installation in providing some degree of protection even as far from the anodes as at the bows of the ship, some 260-ft.

In August 1956 the vessel was dry-docked for her annual overhaul, and the hull, rudder and propeller conditions were examined carefully to obtain a true evaluation of the benefit of the protection installation. The most immediately striking effect of the installation lay in the condition of the propellers. The starboard propeller had been in service for two years, one year without cathodic protection (1954-1955) and one year under protection (1955-1956) and its condition at the 1956 dry-docking was the same as at the 1955 docking, so that its deterioration took place almost entirely during 1954-1955. The port propeller on the other hand had had only one year of service and this entirely under cathodic protection. The photographs (Fig. 4) show quite clearly the benefit which cathodic protection can have upon propeller life, but it must be fully appreciated that this benefit is entirely dependent upon the effectiveness of the shaft to hull bond previously described.

The rudder showed no signs of deterioration beyond that which had occurred during its life up to the time of installing cathodic protection; no pintles required replacement, and furthermore, the removal of the pintles for examination proved to be quite straightforward since there was no corrosion product tending to lock the retaining nuts in place.

With regard to the main body of the hull, the after parts had been substantially descaled of several years' accumulation of corrosion product, and where this thick rust scale had been removed the metal revealed was clean and bright. This descaling effect was particularly noticeable along the keel plate which is, of course, normally difficult, if not impossible of access for manual descaling. It should be appreciated that this descaling process is purely secondary in cathodic protection, the main purpose of which is to prevent corrosion, but it is a very useful "by product" when dealing with older ships, for it enables subsequent paint coats to be applied to a good surface, an essential if the painting job is to be satisfactory.

Following the success of the small installation described the owners decided to adopt full cathodic protection for this vessel, and at the 1956 docking a full array of anodes was installed, three groups on each side as shown in the photograph, Fig. 5. The potential of the hull following this full installation is shown on the graph Fig. 6, it being clear that the whole hull was fully swung to within the normal cathodic protection range. In arriving at the design for this full installation the previous small installation proved invaluable in assessing the anode requirement of the ship for it virtually provided a "swing test."

At the 1957 dry-docking of the "H. J. Hunter" only those anodes fitted in 1955 had to be replaced, for the anodes used have a working life of two years without replacement or maintenance, since the average water resistivity in the operational zone of this ship is about double that of normally saline sea water. The consumption of the midship array during the one year of service 1956-1957 can be seen in the photograph Fig. 7.

Following the 1957 dry-dock examination of the "H. J. Hunter," which fully bore out the expected benefits of a full cathodic protection installation for vessels in this service which was to be expected from the small scale installation, the owners proceeded to arrange for similar full installations to be fitted to two other vessels of the fleet which work in the same service. One of these vessels, the "John Perring," had her installation completed in September 1957 and the other ship, the "Edward Cruse," had her installation put in in November 1957.

All the above work was carried out under the direction of the Chief Engineer, London County Council, J. Rawlinson, C.B.E., M.Eng., M.I.C.E., M.I.Mech.E., assisted by the Divisional Engineer (Mechanical), Commander S. V. Jackman, R.N. (Retd.).

Cargo Handling Equipment of the Modern Freighter

Current Trends for Mixed Cargo

By C. C. RICHARDS, A.M.I.Mech.E.

Statistics have shown that at least 80 per cent. of the world's cargoes handled by cranes is in units of 3 tons or less. The remaining 20 per cent. may well include items involving lifts of 10 tons to 20 tons, and occasional heavy loads of 40 or 50 tons. It is therefore usual for the modern mixed cargo vessel to carry a comprehensive cargo handling equipment designed to suit the class of trade envisaged and the loading facilities available at ports of call.

If reliance could be placed upon port facilities for lifts exceeding 10 tons it would be possible to omit a large amount of expensive and weighty lifting tackle now carried by the ocean-going freighter, used only for a fraction of the time occupied by a round voyage, and involving a capital charge that any shipowner would be glad to eliminate.

In the meantime competition for freights is keen and necessity dictates the prevailing trend, which is to render the modern mixed cargo ocean-going vessel self-sufficient as regards cargo-handling.

An outstanding example of this trend is afforded by the new Israeli motorship "Ampal" built by the Bremer Vulkan of Vegesack, which completed her trials in the North Sea during February last. Built for express service between Haifa, New York and the Gulf of Mexico ports, she is of 15,050 tons d.w. capacity, built to Lloyd's Register class specified "Stiffened for heavy cargoes."

Her deck equipment includes the following: One 60-ton, one 30-ton, ten 10-ton and two 5-ton derricks. These are supported by stayless steel masts, a pair of derrick posts, and the front of the bridge structure.

Four 3-ton electrically driven deck cranes are arranged in pairs over holds Nos. 2 and 3 and Nos. 4 and 5. Electric cargo winches are as follows: Four of 10/2½-tons, six of 5/2½-tons and two of 2-tons capacity. All cranes and winches, including the topping lift hoists are situated on mast houses. The weather deck hatches are closed by watertight rolling steel covers.

A further example of recent date is that of the Swedish 7,100-tons d.w. mixed cargo liner "Elgaren" built early in 1957 for the Transatlantic Company by Stülcken & Sohn of Hamburg. The ship has six holds and a total capacity of 872,561 cu. ft., made up as follows:—

Grain	423,780 cu. ft.
Bale	377,517 cu. ft.
Salted hides	2,400 cu. ft.
Refrigerated cargo	68,864 cu. ft.

It is of interest to observe that with the single exception of a heavy-lift derrick of 40-ton capacity supported by the stayless foremast, the entire cargo handling equipment consists of twelve electric level-luffing deck cranes, four of which have a lifting capacity of 5-tons and eight of 3-tons at a working radius of 43-ft. 8-in. The cranes are also used to operate the folding hatch covers.

A noticeable trend on new foreign tonnage, particularly of German and Swedish origin, is the increasing use of deck cranes. This seems a logical development, for the conventional winch-cum-derrick lifting tackle with its involved system of standing and running gear, can only be regarded as a somewhat primitive substitute for a deck crane of modern design.

This view is supported by no less authority than J. Ramsay Gebbie, C.B.E., D.Sc., who had this to say when delivering the Amos Ayre Lecture (1958) to the Institution of Naval Architects. "The developments in cargo-handling equipment on shipboard have not kept pace with the progress in hulls or machinery. The derrick and winch remain almost the same to-day as they were forty years ago, whereas in general workshop practice, full advantage has been taken of modern mechanical handling devices."

Referring also to the advantages of placing the propelling machinery aft, Mr. Gebbie adds "The advantage of having decks in way of the cargo hatches clear of such obstructions as bridges and accommodation structures in particular, should give greater scope in devising new types of cargo handling appliances as opposed to the present-day derrick and winch, which I have always thought to be a crude method of cargo handling."

An advantage of deck cranes is the large area covered by hook movement. This is the case even when cranes are of the fixed revolving type. If however they are provided with longitudinal or athwartship travelling motion, the working area is increased sufficiently to enable the total number of cranes to be reduced. Furthermore, this arrangement permits the fitting of shorter jibs than would be necessary if the cranes were fixed, thus reducing deadweight and consequently initial cost. The absence of shrouds, guy ropes and topping lifts makes for greater safety and quicker operation. With these obstructions removed, all-round visibility is vastly improved. Level luffing is usually a standard feature of the modern deck crane which simplifies control, economises power and speeds up the cycle of operation. Full-circle power-operated slewing adds to hook coverage. Simple one-man control system with all-round visibility and automatic overload and limit switch devices, ensure maximum safety in operation. A deck crane is available immediately for service without preparation other than luffing the jib into the working position.

It has been stated that a deck crane installation is more costly than its winch-derrick counterpart, but it should be realised that the deck crane is a compact self-contained unit, designed specifically for its job and incomparably more efficient. When, by reason of standardisation of types it becomes possible to apply batch-production in the manufacture of deck cranes, as has already been done in the case of winches, it is probable that the price advantage of the latter would disappear.

Both fixed and traversing type deck cranes ranging from 2-tons to 20-tons capacity have been supplied to various shipowners in recent years by a British firm who have had half a century of experience in the manufacture of ships' deck machinery as well as shore cranes. Fixed revolving deck cranes to lift 20-tons at 40-ft. radius, for use on the new vehicle ferries of the Atlantic Navigation Co. Ltd., were supplied by this firm recently.

Power Transmission

At the moment, due no doubt to the availability of electric current for deck auxiliaries on every cargo ship afloat, the majority of deck cranes and winches are electrically driven. There is also a growing demand for electro-hydraulic transmission. This system has been applied successfully to deck cranes and has the merits of simplicity, flexibility, ease of control and a considerable simplification of the electrical system. In view also of the increasing interest being shown in the employment of alternating current instead of direct current for the operation of deck machinery, it is possible to employ simple and robust squirrel-cage constant speed motors which may be switched direct-on-line.

Having no commutators or sliprings, these motors need less maintenance. Direct current, constant speed motors may of course be used where necessary.

Self-contained deck units are available, each complete with its electrically-driven oil pump, thus eliminating all piping from a central pumping station.

Where it is not advisable to have electric motors on deck, the pumps supplying pressure oil to the dock machines are located in the engine room. By piping the hydraulic motors in series, one pump can supply a number of deck machines, limited of course to the number to be operated simultaneously under full load. Other advantages of the electro-hydraulic system of vital importance at sea are reliability, ease of maintenance and long life due to the immersion of all moving parts in oil.

Diesel-Electric Deck Cranes

Readers of this article will no doubt remember the interest aroused by the launching in 1955 at Newport of the 4,000 tons d.w. motor-ship "Lachinedoc." Built for the carriage mainly of bulk cargoes on the Great Lakes, River and Gulf of St. Lawrence,

Cargo Handling Equipment of the Modern Freighter—continued

this ship is provided with two self-contained diesel-electric slewing jib cranes instead of conventional derricks, mounted on transverse sliding tracks situated between the hatches, enabling them to be winched over from side to side as required. Built by a well-known British firm, the cranes are of standard design, with additional weather protection to suit marine service. They are one-man operated, self-contained units each having a variable voltage generator coupled to a diesel engine. They are therefore entirely independent of external power and make no demand on the engine room auxiliaries. The lifting capacity extends from 3,000 lb. at 40-ft. radius to 6,000 lb. at 27-ft. radius. Normally, lifting is on a single fall giving an infinite range of hoisting speeds between zero and 150-ft. per min. The cranes provide power for operating the hatch covers. They can also be used for handling bulk cargoes with a grab.

This is the first time cranes of this type have been installed on a British-built ship.

Fore and aft movement of deck cranes can be achieved by mounting them on a central rolling section of the steel hatch covers, incorporating self-operated closing tackle. A saving of some 20 per cent. of weight is possible by the use of shroudless steel derrick masts.

Monorail Telpher System

Although used extensively in numerous industrial applications ashore, little if any use had been made of the monorail telpher on board ship until after the Second World War. The monorail track is attached to the deck beams at the top of the hold or tween-deck. On this track, trolleys on ball bearing runners carrying load hooks of capacities up to 2-tons are travelled by pushing at walking pace or alternatively by electrically driven tractors. Curves and junctions are easily negotiated and if required, lift sections can be provided for deck-to-deck transfer.

A system such as this can go far to solve the old problem of handling and stowage of miscellaneous cargo in the wings of holds and tween-decks. No floor space is occupied and it is readily adaptable either to manual or power operation.

A review of cargo-handling equipment would be incomplete without a brief reference to the ubiquitous fork-lift truck which has proved its worth for the operations of stacking and placing packaged goods in the wing spaces of holds and tween-decks.

The growing use of pallets and containers can eventually eliminate the wasteful handling individually of light loads and thus enable available lifting power, whether by derricks or cranes, to be fully and efficiently utilised, up to rated capacity.

The Keller Vibroflotation Process

A Deep-Compaction Technique for Cohesionless Soils*

Vibrations have the effect of rearranging the particle structure of sandy soils, whereby the content of voids is, in general, reduced and the bearing capacity improved. The action of most soil compaction processes is confined to a layer of comparatively limited depth at the surface of the soil. In the Keller vibroflotation process, however, vibratory compaction to almost any desired depth is obtained by means of a device comparable, in principle, to a large " poker " vibrator of the type used for compacting concrete.

The vibrator is introduced into the soil to the required depth and is then gradually withdrawn, thus producing a vertical column of compacted soil. The columns can be formed close side by side or at appropriate distances apart, depending on the composition of the soil, the requisite bearing capacity to be obtained, and the nature of the structure to be built on the soil.

The compacting action of the Keller vibrator is augmented by feeding a continuous stream of water under pressure into the soil. The water is introduced through slot-like openings near the top of the vibrator.

Compaction is accompanied by sliding phenomena within the soil, tending to produce a funnel-like depression. The consequent reduction in volume can be compensated by the addition of an appropriate quantity of soil (this quantity varies between approximately 7.5 and 20 per cent. of the original volume of soil affected by the compacting action). This presents the possibility of adding sand of a suitable grading to make good any deficiences in the granulometric composition of the existing soil.

The vibrator consists essentially of a hollow steel cylinder, 2.50—2.80 m. in length and 0.35—0.40 m. in diameter, containing an electric motor which drives a set of eccentric rotating weights mounted on a vertical shaft. The vibrator is connected to its tubular suspension rod by means of a flexible coupling. Water supplied by a centrifugal pump is fed through the suspension rod and emerges from a nozzle at the lower end of the vibrator while it is being lowered into the ground. In conjunction with the vibration applied, the jetting action of the water converts the soil into a thick fluid in which the vibrator sinks by its own weight. Once the desired depth has been reached, the water is diverted to openings situated near the top of the vibrator and assists in effecting the compaction of the soil.

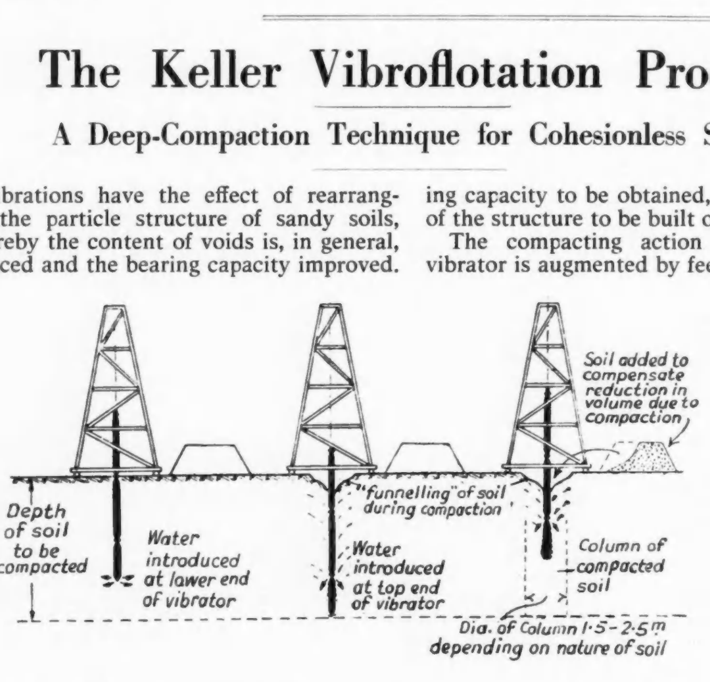


Fig. 1 (left). Diagrams showing operation of Keller vibroflotation process. Left: The vibrator being lowered into ground. Centre: Start of compaction. Right: Vibrator being gradually withdrawn.

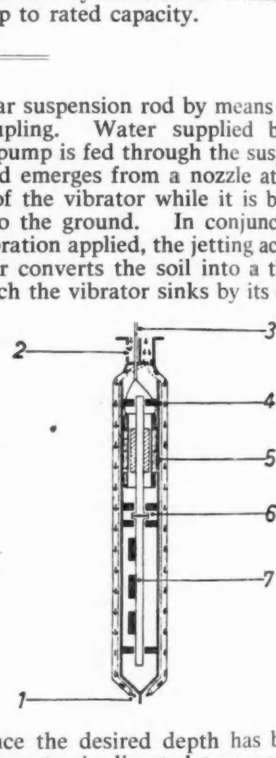


Fig. 2 (right). Longitudinal section through Keller vibrator. 1, Jetting nozzle; 2, Outlet openings for water during compaction; 3, Electric cable; 4, Shaft bearing; 5, Electric motor; 6, Coupling; 7, Shaft carrying eccentric weights.

The vibrator in withdrawn in gradual stages and produces a column of compacted soil up to 2.50 m. in diameter. Experience in compacting soils of varying composition and density has shown that the operation of sinking the vibrator may take from ½ to 3 minutes per metre of depth. The rate of withdrawal likewise varies considerably, depending on the nature of the soil, and takes from 3 to 15 minutes per metre.

The suspension rod is composed of tubular sections which can be coupled together to produce any desired length. The vibrator is suspended from a simple frame or shear-leg type of structure and is lowered and raised by means of a motor driven

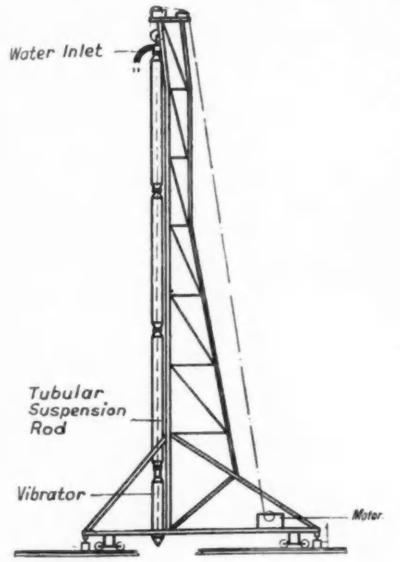
*Abstract from an article which appeared in the German journal "Baumaschine und Bautechnik," December 1957. The equipment described is supplied by Messrs. Johann Keller G.m.b.H., Frankfort-on-Main.

The Keller Vibroflotation Process—continued

winch.

With increasing compaction of the soil around the vibrator the power consumption of the motor increases. The ammeter reading gives an indication of the degree of compaction achieved and helps the operator to decide when to raise the vibrator to a higher level.

The Keller process has a wide range of applications. Thus, with its aid, embankments and dams can be constructed in a continuous operation (instead of layer by layer) and subsequently compacted as a whole. The bearing capacity of piles can be improved by compacting the soil under



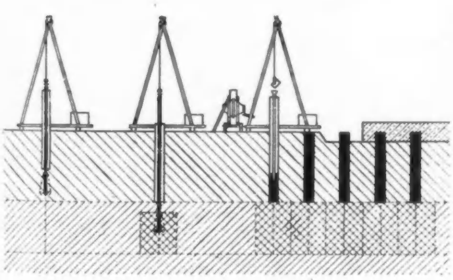
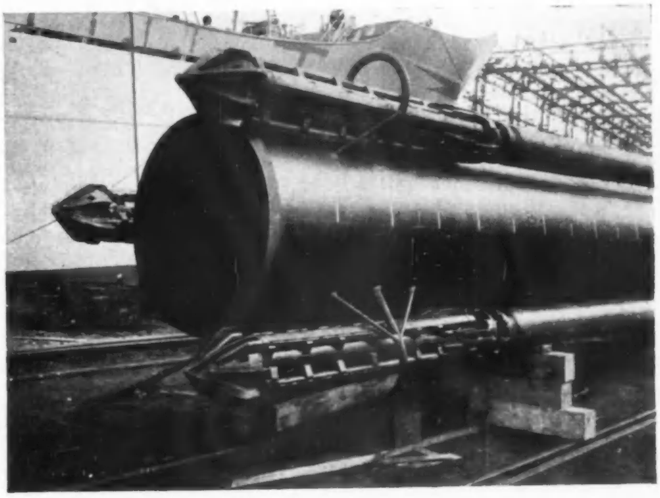


Fig. 3 (above). Vibrator with water supply tubes attached.

Fig. 4 (left). Vibrator suspended from frame.

Fig. 5 (bottom left). Diagrams showing installation of bored piles in conjunction with Keller process. Left: Lowering of shell tube for pile with the aid of a vibrator. Centre: Compaction of soil under tube. Right: Concreting of in-situ pile.

Fig. 6 (right). Steel cylinder for dry dock at Hamburg, showing vibrators attached to lower end.



and around the piles, whereby the end-bearing capacity (toe resistance) and the skin friction are increased. A pile can be installed by lowering it into the ground together with the vibrator and therefore requires no driving. Such piles may, in contrast with ordinary driven piles, be provided with enlarged ends and, if necessary, with projections at intermediate points along the shaft. This is particularly useful in the case of piles designed to act in tension—e.g., for preventing buoyancy uplift in dry docks and similar structures—as the enlarged end produces a considerable "negative" toe resistance. In addition, the compaction of the soil around the pile increases the skin friction.

Bored piles may also be used in conjunction with this process. A steel tube of appropriate diameter to form the pile is lowered into the ground, preceded by the vibrator, which compacts the soil directly below the tube and thus increases the bearing capacity. On completion of the compaction, the vibrator is withdrawn and the tube is filled with concrete. This procedure offers the advantage that the soil under all the piles is given a uniform degree of compaction, so that any risk of differential settlement is obviated. This is particularly important in the case of foundations for statically indeterminate structures or for large and heavy machinery. There is the further advantage that shorter piles can be used, since the lower part of the pile is, in effect, formed by a depth of compacted soil.

By means of the Keller process anchor blocks connected to tie rods may be installed in preference to tension piles for resisting the buoyancy uplift of dry docks. As the anchor blocks do not have to be driven into the ground, but sink by their own weight in company with the vibrator, the tie rods need be dimensioned only for the actual pull that they are required to take up. A variant of this principle was employed in the construction of a dry dock at Emden.* In this case special prestressed high-tensile steel cables were used instead of tie rods. These cables were attached to reinforced concrete anchor blocks installed at depths of 11—14 m. below the bottom of the dock. In general, the provision of tension-resisting anchor blocks or piles under a dry dock permits a considerable reduction in the thickness of the floor of the dock (as the requirement that the weight of the empty dock must exceed the uplift no longer applies), so that a substantial saving in the quantity of concrete used and in the cost of excavation is effected.

One other interesting application of the process calls for mention. At Hamburg a steel cylinder, 33 m. in length and 1.30 m. in diameter, had to be installed to serve as a "pivot pole" for swinging aside a floating dock. This dock normally lies parallel to the shore and would, in this position, obstruct the launching of vessels from adjacent building slipways. During launching operations the dock must therefore be temporary swung out of the way. The specified depth of penetration of the cylinder into the bottom of the waterway was 13 m. It was decided to adopt the Keller process for sinking the cylinder, borings having shown the soil to consist of sand, gravel and stones. Three vibrators were attached externally around the lower edge of the cylinder, which was lowered by crane. The cylinder descended rapidly to within about 6 m. of its final depth of penetration. At this level, however, a bed of very dense and hard clay was unexpectedly encountered. The operation of sinking the cylinder was continued by excavating the material inside it with the aid of chiselling equipment and grabs. Finally the cylinder had to be driven in order to achieve the last 3.40 m. of penetration.

*See "The Dock and Harbour Authority," May 1957.

The Port of Taranaki, New Zealand

Design and Construction of Moturoa Wharf (Part II) *

By W. G. MORRISON, O.B.E., E.D., B.E., M.I.C.E., M.N.Z.I.E., and G. W. BUTCHER, M.C., B.E., STUD.N.Z.I E.

(*Continued from page* 143)

Construction and Site Problems

(G. W. BUTCHER)

Although the new wharf was built on the site of the old structure, the centre-lines diverged by 0° 09′ 40″ to give the required clearances from Newton King Wharf of 320-ft. at the root and 450-ft. at the outer end.

Floating plant for pile driving was not considered suitable for the following reasons:

(i) The problem of ranging which the port is prone to.

(ii) Lack of room for moorings and manoeuvring.

(iii) Lack of water over the mound under the old wharf unless dredging was resorted to. (The depth over the mound varies from 2-ft. to 8-ft. at L.W.O.S.T.).

The contractors elected to retain the existing wharf and to construct temporary timber pile trestles along each side of the wharf parallel to the new centre-line and 65-ft. from it. Tracks were laid on the temporary trestles for a 130-ft. span Bailey bridge which in turn was modified slightly for rail track on its upper chords, on which was mounted the main pile-driving rig. One leg of the 15 ton stiff-legged derrick ran on track along the west trestle, while the main track was constructed on the old wharf strengthened with additional piles and braced at this point. As pile driving proceeded, the old wharf was progressively demolished. When required for deck pours, a light steel trussed bridge was placed in position to close the gap between the old wharf and the new deck.

The new structure was constructed then in reverse to normal practice—i.e., from the outer end shorewards.

Temporary Trestles

The temporary trestles require special mention as they eventually became the contractors' biggest problem when it came to their removal from the berths.

Each bent consisted of three timber piles, each outer pile being driven on a rake so that a skid-mounted pile frame with swinging leaders could drive all the piles without being moved sideways. After driving, each bent was capped and braced and the pile frame winched out to cantilever a further 12-ft. to drive the next bent. Piles were driven with a 9B3 double-acting steam hammer.

Extreme difficulty was experienced in extracting these piles which, because they were in the berths, had to be removed completely to allow for future dredging.

Methods tried with little or no success were a 120 extractor and jetting down to place charges to loosen the piles. Some success was achieved with a skid-mounted rig with a short boom, the necessary pull being achieved with oil drilling blocks and ten parts of line to a winch. Eventually two steel tanks each 20-ft. by 10-ft. by 10-ft. with a net buoyancy of 90 tons were constructed. The tanks were floated in each side of the pile to be extracted and connected together by beams. The tanks were flooded to the required depth and steel channels checked into the pile and clamped together to engage the connecting beams. The tanks were pumped out, usually extracting the pile, although in certain cases the clamps acted as a giant planer. With the more difficult piles, it was necessary to employ a drop hammer at the same time.

Locally known as Kon Tiki, the tanks, unlike their namesake, were rather temperamental and sank on several occasions, necessitating full-scale salvage operations.

A total of 592 temporary piles were driven in the trestles and to strengthen the old wharf. Some piles were extracted and redriven in other parts of the temporary trestle.

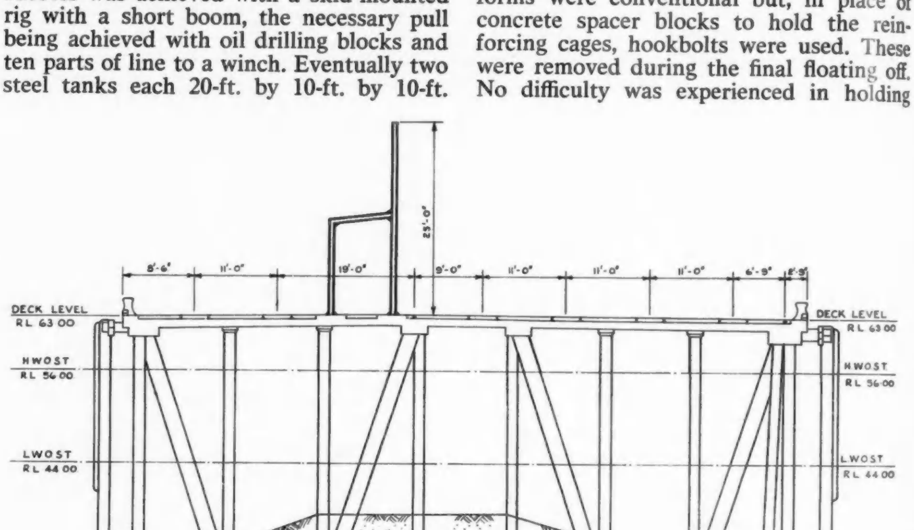


Fig. 8. Typical cross-section of wharf.

Piling

The area available to the contractors was very limited and hampered an efficient layout. It was necessary to lay down three pile beds each with forms for eleven piles. The forms were conventional but, in place of concrete spacer blocks to hold the reinforcing cages, hookbolts were used. These were removed during the final floating off. No difficulty was experienced in holding the cages correctly to give the specified cover of 2-in. over the stirrups.

After curing for from 7 to 10 days under wet sacks, the piles were lifted to the storage stacks by a 90-ft. span travelling gantry equipped with a four-point pick up and pile tongs. Total length of piles cast were:

18-in. x 18-in.	39,733-ft.
24-in. x 16-in.	9,045-ft.

Piles were moved out to the pile-driving plant on two bogies equipped with bolsters on a 3-ft. 6-in. rail track laid on the old wharf. Usually piles for two or three days' driving were taken out and stacked on the wharf in reach of the stiff-legged derrick. The piles were loaded on to the bogies by the gantry and pile casting and stacking area with three beds proved a handicap, necessitating as it did moving the gantry from bed to bed.

Piles were lifted by the crane with a four-

* Paper presented to the New Zealand Institution of Engineers. Reproduced by kind permission.

Port of Taranaki—*continued*

point lifting tackle and braided wire rope straps. The piles were pitched slightly "toe heavy," this being controlled by a small winch mounted on the jib and a light line to the toe. The pile line was attached to a heavy chain wound around the head of the piles. The heaviest pile weighed 12½ tons.

The main pile-driving rig was equipped with a 6 ton single-acting steam hammer. The major portion of the drive was carried out with a 2-ft. 6-in. drop but the last few blows were with a 4-ft. 6-in. drop. No difficulty was experienced at first in getting the face piles well down below the possible future dredge depth R.L. 8 (36-ft. L.W.O.S.T.). From about half way along the east face, however, it was necessary to drill for each face pile and use explosives to loosen up the ground before driving the pile. The procedure was to put down a 4-in. casing by percussion and rotary methods to within 2-ft. of the desired pile toe level. A "bomb" consisting of a 3-ft. length of 1½-in. diameter downpipe filled with up to 5 lb. of polar gelignite and a suitable length of detonating cord was lowered down the casing. The casing was withdrawn and the charge fired by means of a detonator and safety fuse attached to the detonating cord. The method was completely successful.

Extreme difficulty was experienced in accurately predicting required pile lengths for other than the face piles. Numerous schedules for future pile casting were drawn up in what was virtually a "running battle" until the last pile was driven.

A total of 939 reinforced concrete piles were driven consisting of 665 verticals and 274 rakers (including 2 longitudinal rakers). The main pile-driving rig accounted for 821 of these and the remaining 118 were driven by the skid-mounted rig with a 4 ton drop hammer at the root of the old wharf where the piles were quite short.

The average number of piles driven per six-day week was 19.5 and the maximum number in any one week was 40, although towards the end of piling with two rigs working 46 were driven.

Concrete

Concrete was specified as high quality concrete with a cement content of 630 lb./cu. yd. and a minimum crushing strength on a 12-in. x 6-in. cylinder of 4,000 lb./sq. in. at 28 days.

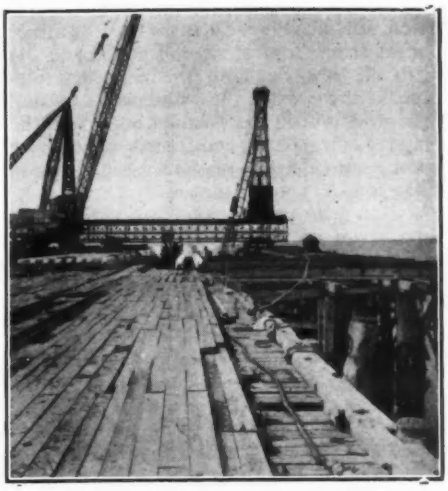
There are practically no sources of high grade aggregate suitable for use in reinforced concrete marine structures in the Taranaki province. The following are results of tests on aggregate from a source in north Taranaki typical of most aggregates found in the area.

Physical Properties

(i) Visual: A large proportion of the particles were porous and weak. Some could even be broken with the fingers.

(ii) Abrasion: The aggregate gave a loss of weight of 43.6% on the standard Los Angeles abrasion test.

(iii) Sodium Sulphate Soundness Test: After the first cycle, 3 to 4% of the particles showed signs of splitting and disintegration.



Bailey Bridge of 130-ft. span with pile driving rig on upper chords to the right. Temporary trestle carrying rails for bridge is seen at mid-right.

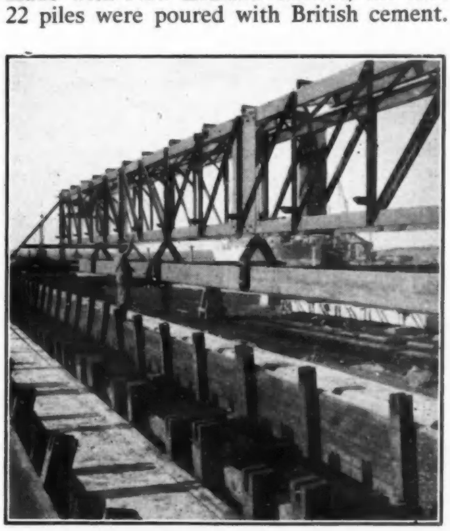
Petrographic Character

The aggregates consisted entirely of chips of andesite containing varying amounts of volcanic glass in their groundmass. The amount of glass was estimated to be not greater than 10% by volume.

In view of the results of the tests and the other factors involved, it was decided to use greywacke from the Rangitikei River at Kakariki. The extra cost over local aggregates amounted to 2½% of the total cost of the new structure.

Bulletin ST5 of the N.Z. Portland Cement Association was used as the basis for mix design throughout the work. The required minimum compressive strength of 4,000 lb./sq. in. and water/cement ratio of 0.47 was the basis for the mix design.

Although the original trial mixes were made with New Zealand cement, the first 22 piles were poured with British cement.



Gantry lifting piles from casting bed.

Six sets of test cylinders taken from these early pours gave 28-day strengths which were all much lower than the required minimum, some being only 70% of this value. Without altering the mix, later results with New Zealand cement gave the required strengths. Representations were made to the cement suppliers and for the remainder of the work direct shipments of New Zealand cement were received.

Weigh batching of aggregates and whole bag mixes were used throughout the work. Two gradings of coarse aggregate nominal ⅜-in. to ½-in. and ¾-in. to 1½-in., and fine aggregate were all batched separately. At first it was intended to control rigidly the water/cement ratio by frequent moisture content tests with a pycnometer but it was soon found that the variations in moisture content of the aggregates were too rapid. Eventually the amount of water added was controlled by the slump test and batching cards were made up for aggregate corrections for particular water meter readings on the basis of an assumed (moisture content of sand)/(moisture content of coarse aggregate) ratio of 4.

Towards the end of the job a Kelly ball meter was used to speed up determination of slumps. The calibration for the particular mix used is shown in Fig. 9. Compression tests were carried out on 87 sets of 12-in. x 6-in. cylinders and a histogram of results is plotted in Fig. 10. The average 28-day strength was 4,657 lb./sq. in. with a standard deviation of 589 lb./sq. in. resulting in a coefficient of variation of 12.6%. Sixteen tests fell below the specified strength but 6 of these were mixes containing the British cement previously discussed.

Durability of Timbers

Local opinion was that, at Port Taranaki at any rate, turpentine piles were:

(i) Attacked by *Teredo* and *Limnoria*;

(ii) Extremely brittle and subject to splitting.

It was also claimed that nearly all the turpentine piles used in the past had since been replaced, and that the life of a turpentine pile in the fender system would be not greater than 10 years.

Consequently tenders for the fender system and timber end were called on the basis of sheathed Australian hardwoods, chiefly ironbark, with an addenda price for turpentine.

Subsequent inspection of the piles in the old Moturoa Wharf, however, disclosed the fact that over 100 piles were turpentine; most were 30 years old and still in very good condition, while some were 10 years old and in excellent condition with some bark still intact. At the same time, an inspection was made of the sheathed spring piles on the main Newton King berth. It was found that 21 of the 49 piles had the sheathing removed to varying extent owing to heeling of ships in the berth. *Teredo* attack of the portions of pile made bare by the chafing was severe in most cases.

In these circumstances, the Board agreed to the use of turpentine piles throughout.

Port of Taranaki—*continued*

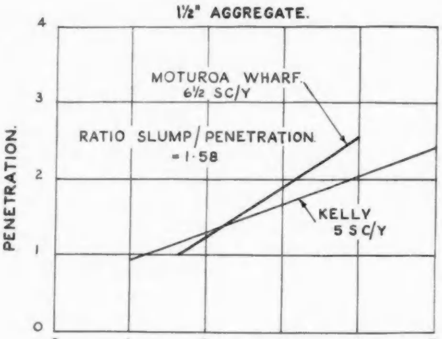


Fig. 9. Calibration, Kelly ball meter.

The contractors' temporary staging in which new unsheathed hardwood piles (mainly blackbutt) and local bluegums were used suffered severely from *Teredo* attack from mud level up the pile some 6 or 8-ft. The hardwoods were honeycombed for depths up to 4 or 5-in. in a period of only 8 to 12 months, while the attack on the bluegums was so severe that when the bracing in a bent was removed some of the piles collapsed. Recent accelerated exposure tests on small timber specimens have shown that, in general, marine organism attack is slightly more severe at Auckland than in Port Taranaki.

Ranging or Surging in the Harbour

Mention has been made previously of the phenomenon of ranging or surging (also known as run, send, groundswell, seiche, etc.) experienced at Port Taranaki. Harbours which flank a wide expanse of ocean and lie on or near the tracks or line of approach of atmospheric disturbances all experience trouble with ranging to a greater or lesser extent. Cape Town Harbour is probably the best known example of such a port subject to severe ranging.

Fortunately conditions at Port Taranaki are not as severe as those at Cape Town. Apart from the northerly groundswells experienced usually during the summer months from tropical storms passing to the north of New Zealand, the most troublesome is the westerly groundswells caused by depressions on the Tasman Sea. With the westerly the worst conditions occur two hours each side of high tide when the tide gauge registers more than 8-ft.

Wilson who investigated the problem at Cape Town during and after the war years says in a paper in the "Dock and Harbour Authority" (March, 1954) dealing with the problem: "The energy of the highest frequency waves (periods less than 15 sec. say) is largely destroyed in the surf along the coast, but the longer groundswells surge up the shore without breaking and reflect to form standing waves with oncoming members of their trains. Where the topographical features of a bay inlet or semi-enclosed basin favour it, the underlying groundswells are repeatedly reflected and form resonant oscillations or seiches. The basin selects for this purpose only those of the incident waves as have about the same periodicity as its own natural periods of oscillation. The special property of a seiche consists of a synchronous movement of the entire water mass of the bay or basin in which every water particle moves in phase with every other."

The breakwater-shore system at New Plymouth is in effect a semi-enclosed basin of complicated shape. The phenomenon appears as a disturbance of moored vessels causing them to move longitudinally (fore and aft), laterally ("yawing" and seesawing with often bow or stern "quarters" moving in rapidly), and vertically sometimes with a roll. No simple inexpensive solution to the problem is known to exist but various measures can be taken to reduce the effects on shipping. Wilson in the same paper states: "Any mooring technique which ensured permanently tight ropes, coupled with the use of shock-absorbing fenders, would provide a palliative solution to the problem without eradication of any essential features of the surging."

The practice of keeping moorings tight has been carried out for a considerable number of years at New Plymouth where coirs with a breaking load of 37 tons are fitted with large thimbles through which are passed "lanyards" from the bollards. The moorings are tightened by a tractor pulling in one end of the lanyard. Up to 10 coirs per ship have been used on occasions, which accounts for the large number of bollards provided on the new wharf. The shapes of the bollards are different from those normally used in most ports

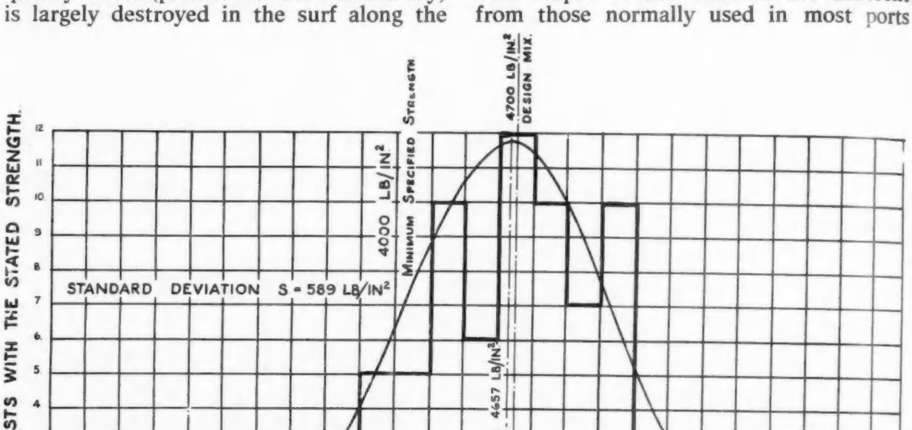
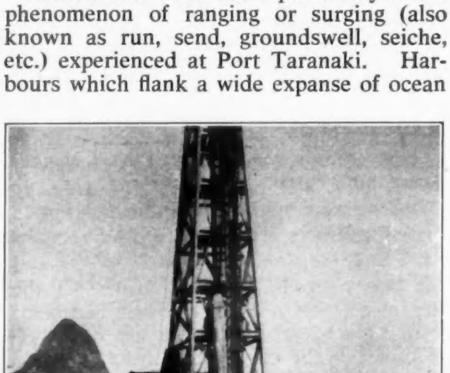


Fig. 10. Histogram of compressive strengths of 87 tests compared with normal curve.

because of the problem of lanyards "bunching" and the difficulty of pulling up the moorings when this occurs. During periods of ranging, the harbourmaster's staff are continually adjusting and replacing moorings. In order to ensure permanently tight moorings, any fender system should not be too soft.



Driving timber piles for temporary trestle.

Labour and Plant

The principal construction plant used was as follows:

15 ton stiff-legged derrick with a 120-ft. jib.
60-ft. steel pile frame with swinging leaders and a 6 ton single-acting steam hammer, mounted on a 130-ft. span Bailey bridge (front truss triple double construction and the rear truss double-double).
65-ft. timber pile frame skid mounted with normal and swinging leaders to take a 9B3 double-acting steam hammer. (This plant was later equipped with a 4 ton drop hammer for driving the shorter reinforced concrete piles at the root of the wharf).
½ cu. yd. mixer and weighbatcher.
½ cu. yd. shovel fitted with a clam shell for loading the aggregate hoppers of the weighbatcher and for unloading rail wagons.
1 cu. yd. front end loader.
45 kVA. butt welder.
3 ton truck-mounted crane.
90-ft. span pile gantry.

The peak labour force was 148 men but the average over the major portion of the job was 120 men.

New Jetty at Yelland, North Devon

Discharging Installation for Tankers

(Specially Contributed)

In continuation of their policy of delivering supplies by coastal tanker, a new depot for Shell-Mex and B.P. situated at Yelland, between Barnstaple and Bideford on the North Devon coast, was officially opened on the 18th June by Major Sir Dennis Stucley, Bt. D.L., J.P., C.A.

The tank farm is fed from a jetty some $\frac{3}{4}$ mile away near the mouth of the River Taw about $\frac{1}{2}$ mile below (South-west of) the new East Yelland Power Station, and is readily accessible from the sea, although in a situation sheltered by Crow Point. The banks are not steep at this point, and it was necessary to construct an approach and jetty head having a total length of 540-ft. from the top of the flood bank. As will be seen from Fig. 1, the approach to the jetty head, except for a short length at the shore end constructed between mass concrete retaining walls, is carried upon cylinders. These are spaced at 30-ft. centres. The first eight supporting cylinders are single, 6-ft. 2-in. diameter, the next five being in pairs. Except for the five cylinders nearest the shore all cylinders are founded upon larger ones 7-ft. 8-in. diameter, set on the rock. This rock was found at depths below beach levels not exceeding 8-ft. The approach gangway consists of simply supported reinforced concrete T beams 30-ft. long.

The jetty head has a total overall length of 83-ft., the wings at each end being 14-ft. wide, and a central portion 25-ft. wide. The head is of cellular construction, cells being filled wth excavated material from the fore-shore, the whole being founded upon 25 cylinders set upon the rock.

The tidal range between mean high water and mean low water springs is 20.4-ft. and the deck level is some 5-ft. 4-in. above this. It is not uncommon, however, for the tide to rise several feet above the level of mean high water springs, and, indeed, to flood the ground adjoining the river. As, however, the flood bank is slightly below the level of the deck there seemed to be no point in making the latter any higher. It will be seen that vessels discharging at this jetty must lie aground at low water, unless they have completed the discharging of their cargo in time to leave, but as the berth is composed of sand and silt there is no particular objection to this, and the same thing happens to the vessels bringing coal to the power station. At or near low water the situation is well protected, and there is no range of any moment. The usual crane for handling the hoses and a cabin are situated on the jetty head (Fig. 2).

With reference to the oil pipes leading from the discharge point to the tank farm, these are laid to a gradient over the whole distance, the highest point being at the jetty head. Although not very obvious from the photograph, it amounts to $\frac{1}{2}$-in. between each of the pipe supports, and enables the pipes to be entirely emptied by gravity. This also applies to a water pipe running to the jetty head.

The actual sinking of the cylinders, especially at the jetty head, was very much facilitated by the fact that the excavated ground was found to be practically impervious to water; therefore, by forming a bank of excavated material round the areas as they were dealt with, the contractor was able to work for a considerable time after low water. It was at first thought that a half tide coffer-dam might be necessary, but, in fact, it was never needed, and no particular difficulties were met with throughout the entire period of construction.

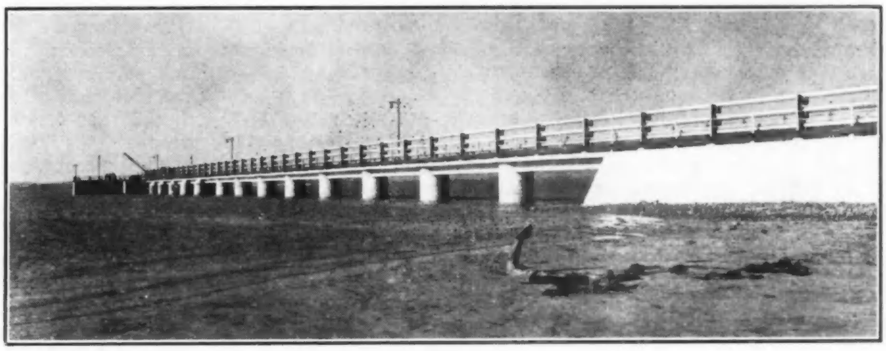


Fig. 1.

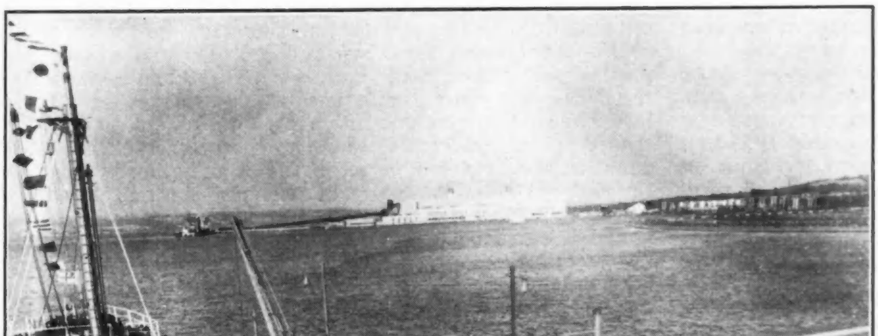


Fig. 2.

The mooring of vessels discharging at the jetty is catered for by 6 Bean bollards on the jetty head, and, in addition, there are 7 shore moorings from which the ropes are led to the jetty head for use as required under the various conditions of tide and weather obtaining from time to time.

The main contractors for the jetty were Geo. Tate and Son Ltd., of Rotherhithe, and the consulting engineers W. H. S. Tripp and Partners, of Newcastle-upon-Tyne.

Floating Dock at Melbourne

Melbourne Harbour Trust has purchased a 1,000-ton floating dry dock from the Department of the Navy which is to be used to carry out underwater maintenance on floating plant. The dock, which was built in 1941 and has been used by the Trust before is to be sited at Williamstown.

A Remedy for Dock Strikes

Tentative Proposals for Removing Causes of Unrest

By "POSEIDON"

The concise summary of the recent unofficial dock strike which appeared in the August issue of "The Dock and Harbour Authority," stresses several disquieting features of the latest in the series of stoppages in the dock industry. From the account it is clear that:—

1. Conditions will continue to exist where merchants' stocks cannot be cleared from the premises of public warehouse-keepers if the men who normally work these are on unofficial strike. The trader is denied access to his own goods even when, as in some cases, he has been willing to apply with his own labour.

2. The Minister of Labour does not propose to amend the Dock Labour Scheme although it has proved ineffective to cope with the situation.

3. The largest trade union concerned, whilst deprecating wild cat strikes is certain that the introduction of unregistered labour would be "the one sure way to dislocate the ports of Great Britain." As though they were not already dislocated. In other words, the right to strike unofficially and in breach of agreements, is more worthy of preservation than the merchant's right to his own goods.

One is tempted to ask what the union's attitude would be to unregistered clerical labour were it to be used to replace the staff of the N.D.L.B. that is responsible for paying the dockers, should these clerks start an unofficial strike.

4. Nothing more need be expected from a government that, like its predecessors, is allergic to dockers and would rather not be reminded of the problems they persist in raising.

To this summary could be added a few further facts that have only too quickly been forgotten. Eighteen thousand union members responded to an unofficial call to cease work and more than 100 ships were idle for varying periods, up to three weeks. Much of the money lost in wages has since been made up at enhanced overtime rates. Continental ports have again profited by diversions and our overseas customers have been further exasperated by delays in receiving consignments.

This is the dreary pattern only too familiar to those whose livelihood is gained in shipping and in the handling of cargo. From 1947-55 an annual average of 344,400 man-days was lost in the ports of this country. The N.D.L.B. regarded 1957 as a good year; only 94,077 man days were lost in disputes. Nineteen fifty-eight has already reverted to the normal pattern. Governments of both parties have confined their constructive action to appointing commissions of enquiry. Some have been more futile than others. From none has emerged a cure for the chronic malaise that bedevils dockland.

Since an official solution of the problem has ceased to be expected by the long suffering employers it is time that an attempt was made, in however a humble way, to outline the cure for a disease that has for too long drained away the strength of our industrial body. We are only too aware that the cumbersome machinery of a Royal Commission will have to take its course before a government, nerved to cut out the cancer, could be persuaded to take remedial action. That the Commission would learn in its ponderous process that which employers could tell a minister across the table in half-an-hour, would have to be accepted as part of the working of a democracy.

It is far from the writer's intention to pose as a pundit to whom the answer to this vexed problem has been vouchsafed. Shooting an answer "off the cuff" has but one merit. It invites contradiction; criticism engenders interest. Unless the industry is content to limp along, suffering patiently the effects of its own inherent vice, somebody must offer a solution, even if it serves merely as a "cockshy." It is in the hope that public opinion may be roused from the inertia that tolerates these industrial dislocations, almost predictable in their frequency, that the suggestions that follow are made. They are put forward with all deference and the certainty that they will not find general favour.

1. **The Single Employer.** The Devlin Committee, reporting in 1956, felt that the best cure for the unrest was to perpetuate the conditions that the employers considered caused it. They noted 1,248 employers of port labour[1]. The Committee refused to appreciate the loss of the employer-workman relation, a loss that had been generally accepted since the N.D.L.B. operated. They went further and claimed that it had never existed[2].

Until this relation is restored there will be no peace in dockland. It can hardly play a part in an industry where a man may work for half-a-dozen employers in a week. How has this condition, unknown elsewhere in industry, come about? Provided that the N.D.L.B. licence is obtained, a master stevedore is free to offer his services for the loading or discharging of such ships as he may secure. Out of the 74,471 registered dockers[3] the Port of London Authority employ an average of 6,000 daily[4]. The B.T.C. are the next largest employers. One thousand two hundred and forty-six employers, in 1956, drew on the remainder as they were required. Some had regular "followings"; others drew men from the pool on the infrequent occasions that they secured a ship. That is briefly the pattern of the employers. In 1890 the London & India Docks Joint Committee, sickened by the Great Strike of 1889, badgered by shipping companies and with their chairman a dying man, gave up the ship work in their transit docks. They would have given it up in the warehousing docks also had the unscrambling been practicable. Instead of one employer, 40 sprang up overnight. Sir Joseph Broodbank, the historian of the port and a witness of this capitulation, predicted that peace would not again come to the port until the decision was reversed. To-day there are not 40 but 440[5].

The process must be reversed. The Port of London Authority, with their experience of ship work, should be given powers to revert to the status of single employer that their predecessor so faineantly surrendered. Operationally it is possible. By rationalising the employers, eliminating by compensation those "tassels on the fringe of the industry," and by integrating the staff of employers of substance, the changeover could, it is considered, be as bloodless as that which brought the separate dock companies under the Authority's management in 1909. Fifty years have welded the manifold customs and traditions of several dock companies into a viable whole. If it took as long to build up a ship discharging and loading autocracy the time would be well spent. London has a separate problem—the wharves, employing pool labour that, it can be said, seldom ventures into the docks, save during slack times. Many wharves are old, built in a manner that precludes mechanisation; others cannot be extended nor re-constructed. Surely rationalisation of the wharves could be attempted? The setting up of an authority parallel to the Port of London Authority, but responsible for all the wharves within tidal limits would create two employers in London who could be relied upon to work in harmony and have a common labour policy. It would spell the end of that most profitable of sports, for which there is no close season, the playing off of one employer against another.

2. **The Employers' Control of Labour.** The N.D.L.B., the brain child of Ernest Bevin, has no parallel in nature. It has no progeny although there are 74,000 dock workers on its register. Its disciplinary powers were born of appeasement out of indecision and they have been proved ineffective as soon as the number of culprits runs into double figures. Having handed over the quota of pool men each day to an employer, it is powerless to influence their working conditions. It can do nothing to get them back to work during a strike. Its part in a stoppage is confined to publishing the daily figures of men not at work. The welfare activities for which it is responsible are achieved, so many think, at too high a price. The "scheme" is completely impersonal; the N.D.L.B. was meant as an agency for supplying labour. Under its constitution it can never be more than this.

Under the single port employer, or dual employers, in London, the most stable portion of the existing register, the weekly men or the "perms" as they are called, of whom there are some 17,000[6], would be immediately increased. The one bright feature

A Remedy for Dock Strikes—continued

in the jungle of post war labour has been the degree of loyalty shown by the permanent men. That it has not been 100 per cent. is understandable. The question arises whether the Board, or the "scheme" would be necessary with a single employer. There would be little point in the latter paying in the levy with one hand and paying out "fall back" with the other. Recognition of the principle that part of his completely permanent staff had to be paid this week for doing nothing, so that they should be available for work next week, would save the present cost of the scheme, which was £5½ million in 1957[7].

3. **A Single Union.** No single cause has taken more out of the docker's pocket and caused employers and the country more loss than the feud between the White and the Blue unions. Commissions of enquiry have deplored its effects whilst recommending its abolition. Pious hopes will not prevent the costly quarrels of two unions, ostensibly in being to further the interests of the dock worker. Absorption or integration must be carried out by legislation, and the sooner the better. The luxury of domestic bickerings and inter-union squabbling can no longer be afforded.

Whilst on the subject of unions, it is far from clear why union management has been content to handicap itself and its members, by refraining from copying capitalist methods of doing business. Part of the paraphernalia of big business is its managerial corps, the members of which are suitably paid, housed in more than adequate surroundings and ensured sufficient leisure to think and to plan on a big scale. They are able to meet, on terms of equality, rival managements, both here and abroad; they are equipped to meet them socially as well—and this will cover more than sitting down to table.

The leaders of the big unions are big shots and deservedly so. Why do the unions cling to the belief that only those men who have been through the mill can understand and argue on working conditions? Why is this out of date mystique, this esoteric view of craft "secrets," that could be quickly absorbed by an average intelligence, allowed so to handicap the unions in their business negotiations? Were the unions run by the managerial class they would, at all stages of the conciliation machinery, be in a better position than they are now, to settle the frequent causes of dispute that are discussed in the "plush" conditions that the employers provide. If it is a principle of the Welfare State that labour requires no training before taking its share in the management of the nationalised industries, would it tax unduly the managerial capacity of big business to run the unions?

Professor Jack's committee that enquired into the recent unofficial stoppage at Smithfield, observed, in referring to the handling of the dispute by the T. and G.W.U. "a certain lack of confidence on the part of their officials in their own ability to make a direct approach to their members." To quote a leading light in Sunday journalism, "The union organisations here are understaffed and the leaders are overworked and underpaid."

May not these unhappy conditions be a contributory cause to the frequent strikes? How can officials exact discipline when their pay is known to compare so unfavourably with that drawn by the majority of the men they represent—and who value them accordingly. Money talks and nowhere with so clear a note as in dockland.

4. **The Benefits Accruing.** How would the turn-round of ships benefit from the above suggestions apart from the period of peace for which the country longs? A few of the more obvious advantages can be listed. Others would emerge as experience was gained.

(a) The "best brains" of the industry would be available for ship work as a whole; the standard of output, instead of remaining stationary or declining[8], would rise as the substandard employer was eliminated.

(b) Gear and equipment would be pooled and rationalised. At any time there is much gear not in use by employers, whilst others find their output curtailed by lack of suitable gear. This would also apply to mobile cranes, fork-lift trucks and items of major port equipment.

(c) Port Authorities anxious and willing to spend on mechanising cargo handling processes, repeatedly find their efforts thwarted by the poor co-operation they have learnt to expect from the less enlightened employers. Mechanisation that stops at the ship's rail is a reproach to a port. A single employer would have the process from the ship's hold to the back door of the shed under his hand.

(d) No serious attempt affecting dock workers has been made to train men for the industry. Whilst firmly opposing nepotism in principle, dockers have insisted on the right of "sons of dockers" to a place on the Board's register[9]. This is considered to be sufficient qualification. Rotterdam has a training school for dockers and receives youths of school leaving age. The course lasts until the potential dock worker is old enough to begin work in the Rotterdam docks. It includes moral, social and economic training as well as fully covering the technical side. The cost is borne by the State and by shipowners. Rotterdam has not had a strike since a minor stoppage in 1946. Employers there have assured the writer, who has been privileged to watch the training, that the type of stoppage endemic in the ports of this country would literally be unthinkable among the graduates of the Havenvakschool[10].

Conclusion. Whilst there is no need to despair of finding a solution, it will be apparent that no wave of a wand will bring peace where for years there has been no peace, and where the essential conditions for peace in industry are notoriously absent. Surely the first step—and this can admit of no political angle—is to introduce conditions that are present, and are known to contribute to peace, in more favoured industries. Dock work carries more than its share of inherent disabilities. Much of it is arduous and has to be performed under weather conditions that permit of little amelioration. Distances are great and amenities few. Piecework, whilst it rewards the industrious, too often serves as a forcing ground for disputes. Union loyalties are still at the stage when "one out, all out" is accepted by too many as the orthodox preliminary to reasoned discussion. The dockers' work is done against a background of lightermen, tally clerks, rail workers, carmen and market porters, all of whom must needs be happy in their work before there can be peace in the docks.

The point will certainly be made that in the early stages of the cure a strike will be precipitated. This is undoubtedly true. Appeasement has, over the years, encouraged and tolerated strikes at regular intervals. Not even the Devlin Report troubled to list the causes of more than six major strikes in eight years. It ignored 30 smaller ones and a number of minor disputes[11]. There is much to be said for the strike to end all strikes. It is a fact remembered still, that the General Strike of 1926 ushered in the longest period of peace within living memory.

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Engineering Workshops for British Waterways

New engineering workshops at Wigan on the Leeds and Liverpool Canal have now been completed for the north-western division of British Waterways. Built on a 2-acre site (with an existing dry dock) alongside the canal, these workshops will now become the principal centre for repairs to all types of waterways craft and plant. The new workshops are housed in a building about 320-ft. long by 90-ft. wide by some 20-ft. high, and they include two slipways, a fitting shop, blacksmiths' shop, lock-gate shop, carpenters' shop and sawmill. The slipways can accommodate four 60-ton barges at one time.

The St. Lawrence Seaway

Deepening Channels connecting the Great Lakes

By JOHN GRINDROD, B.A.(Com.).

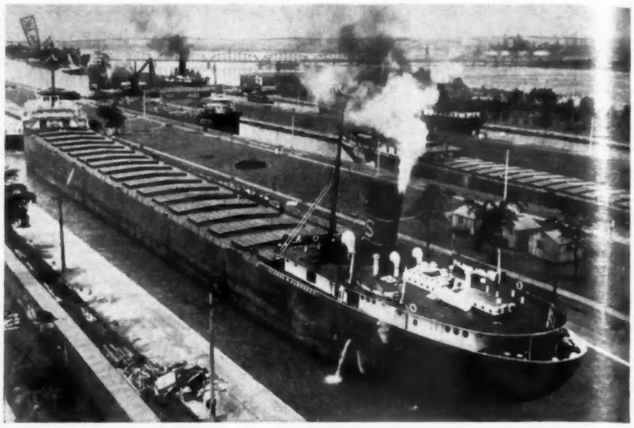
With the St. Lawrence Seaway project from Montreal to Lake Erie scheduled to be inaugurated for navigation at the opening of the 1959 shipping season, considerable thought has also recently been given to the need for creating better navigation facilities through the channels connecting the Great Lakes westward of the point where the Seaway project finishes so as to extend deep water navigation well into the heart of the North American continent. This work was duly authorised by an act of the United States Congress on March 21st, 1956, and its total estimated cost, including costs of surveys, engineering, field supervision and administration will be in the region of $150,000,000. Deepening of the channels to 27-ft. to bring them into line with the Seaway project was initiated in the 1956-57 fiscal year and Congress appropriated $13,000,000 to continue the work in the fiscal year starting July 1st, 1957.

These connecting channels form the links which make the Great Lakes the greatest inland waterway in the world. Together with the St. Lawrence River, the system provides 2,300 miles of navigation from Duluth to the Atlantic Ocean.

Immediately following the deepening of the Connecting Channels and probably to some extent concurrently with this work, a major programme for the deep dredging of the Great Lakes harbours will be put in hand so as to provide suitable accommodation for the deeper-draught vessels which will then be able to operate on the Great Lakes services as well as those coming into the lakes through the St. Lawrence Seaway. In the absence of natural harbours around the Great Lakes, man-made facilities have had to be formed by dredging and the construction of piers and breakwaters. The U.S. federal government has participated in 60 such schemes and six others having been built on the American side by private enterprise.

Apart from traffic coming into the Great Lakes from the St. Lawrence, there is a vast tonnage of shipping operating in these inland waters and as much as 25 per cent. of the total waterborne commerce of the United States, including all ocean ports and inland waterways is located within this area. To cope with this, the Connecting Channels, which are not naturally deep, have had to be progressively deepened over the years and much of this work has been done by the U.S. Corps of Engineers, who are also responsible for the current projects. In general, there are at present two-way channels in these waterway links: an up-bound channel and a down-bound channel. The deepening plan now under way provides for increasing the controlling depths of up-bound channels from 21-ft. to 27—30-ft. and the down-bound channels from 24.8-ft. to 27—30-ft. and will affect the connecting channels between Lakes Erie, Huron, Michigan and Superior. These recommended depths will increase the safe draughts for lake vessels from 22.3-ft. to 25.5-ft. in down-bound channels and from 18-ft. to 25.5-ft. in up-bound channels when the ruling lake level is at its low-water plane.

A freighter entering the Port of Milwaukee, which has excellent harbour facilities open to the largest Great Lakes vessels.



Vessels in locks, St. Marys Falls Canal, Sault Ste. Marie. Michigan.

Work involved in the project will fall into five main sections: the St. Mary's River section between Lake Superior and Lake Huron; the Straits of Mackinac section between Lake Michigan and Lake Huron; the St. Clair River section between Lake Huron and Lake St. Clair; the Lake St. Clair section; and the Detroit River section between Lake St. Clair and Lake Erie. Except in parts of the anchorage areas in the St. Marys River and in the middle Neebish and Amherstburg Channels, the dredge cuts will be fairly shallow. Most of the dredging will take place in sheltered waters though there are some potential storm and rough water areas. Some 699,500-ft. of waterway of width varying between 300-ft. and 5,300-ft. are involved, though the latter width is exceptional and the maximum is usually 1,000—1,500-ft. Allowing for over-depth dredging, an estimated 3,702,000 cu. yds. of ledge rock will have to be removed and 24,472,000 cu. yds. of material excavated by dipper or bucket dredger and 16,093,000 cu. yds. excavated by hydraulic dredging. In addition, there are estimated to be about 4,300,000 sq. yds. of area which require sweeping and clearing to remove shoals for depths of from a few tenths of a foot up to 1-ft. or 2-ft. This material consists generally of ledge rock, boulders and clay in the lower Detroit River.

Instead of widening the Southeast Bend in the St. Clair River, an alternative cut-off channel is proposed from the upper end of the Bend to the channel in Lake St. Clair. Since such a cut-off canal would be in Canada an agreement with the Dominion would be necessary. Should the scheme go through, the quantity of materials to be dredged hydraulically would be considerably increased.

Each reach of the channel has been studied to determine the total allowances required between depth and safe draught in order to establish the proposed project depth, consideration being given to the fluctuations of lake levels above their respective datum planes. An additional clearance was also allowed in rock bottom channels in view of the potential hazard of rock being turned up above grade.

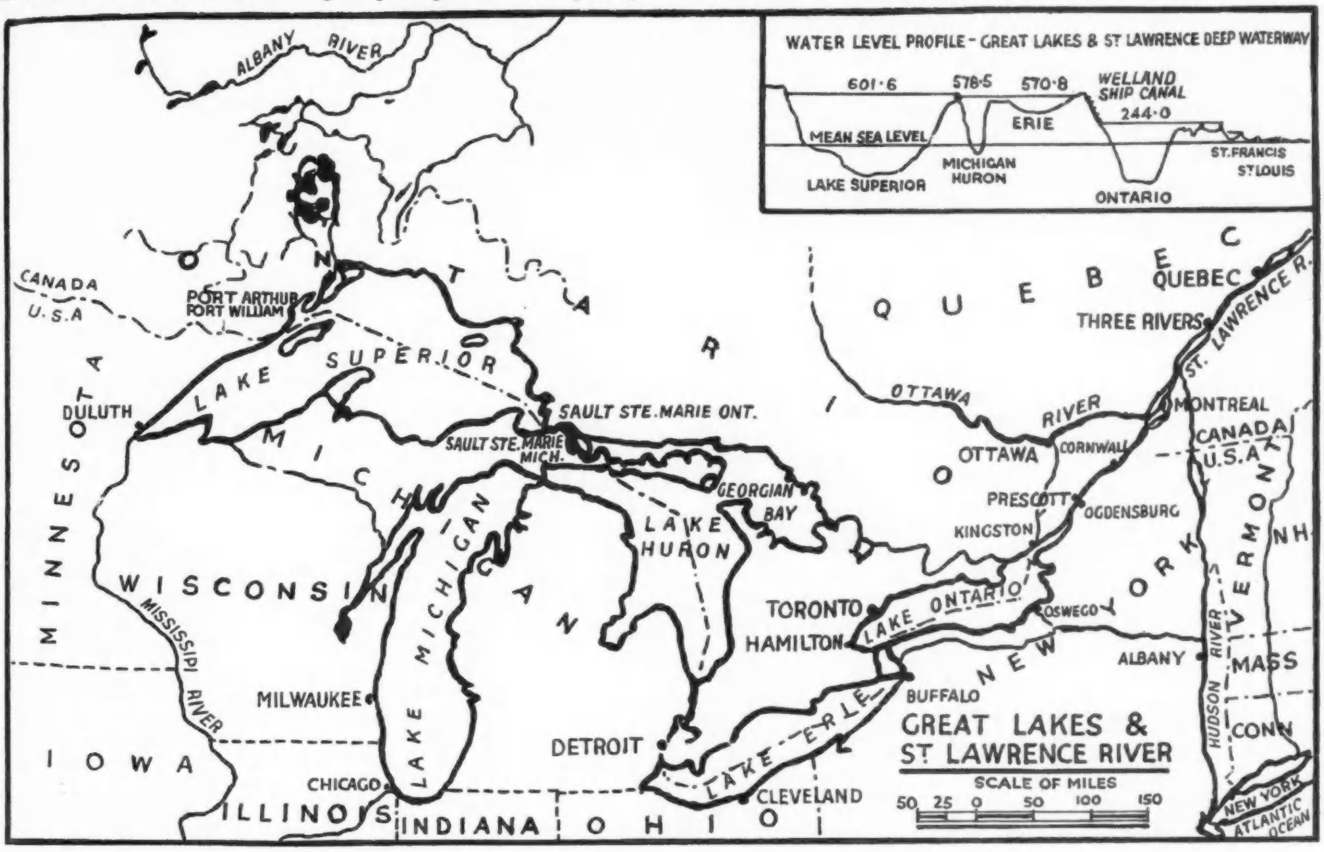
Dredging is being planned so as to avoid interference with the traffic through the channels which averages one ship every 13 minutes through the St. Marys River, one every 15 minutes through the Detroit River and one every 17 minutes through the St. Clair River. Dredging will also be limited to the ice-free season.

All types of equipment normally used for channel dredging, such as dipper dredges, bucket dredges, hydraulic dredges, derrick boats, drill boats, tugs, dump scows, sweep rafts and other attendant plant will be needed for the project which, it is thought, could possibly be completed for the opening of the 1963

The St. Lawrence Seaway—continued

navigation season. A survey of available contractors' plant at the beginning of the scheme, which is bigger than any former dredging programme on the Great Lakes, indicated, however, a lack of equipment to complete the project to such a schedule in addition to other essential dredging work and the need for mobilising or constructing such equipment was being considered.

The possibility of using other than normal dredging methods is also being considered for certain reaches such as the downbound West Neebish Channel in the St. Marys River which will have to be closed to traffic during deepening. When this passage was originally constructed in 1906-08 a cableway was used for removing excavated material, and, for deepening operations in 1931-33, cofferdams were built so that excavation by crawler-type shovels could be carried out in the dry.



During the years, improvements in channel depths have been made from time to time and these have been followed by corresponding harbour development. With the deepening of the channels, also, shipowners have increased the draughts of their vessels to take full advantage of such improvements with the effect that some of the more recently built ships have been up to 710-ft. in length, up to 75-ft. beam and with maximum draughts of from 24.5 to 26.9-ft. There are, in fact, about 50 vessels in the Great Lakes fleet which can load to draughts of 24.5-ft. or more. Some of these vessels, under present conditions, can only load to reduced draughts except during the relatively short periods when lake levels are at extreme high stages.

Not only will the deepening of the Connecting Channels be of great benefit to these existing vessels, but it will be important in respect of the planning of new ships to take the place of the many older smaller craft which are nearing the end of their economic lives.

On the Canadian side of the Great Lakes, also, plans are being studied for lake harbour improvements, two of which would coincide with the opening of the Seaway and two with the U.S. Corps of Engineers' completion of dredging in American waters, possibly in 1962-63. Involved in these schemes are four of the Upper Lakes ports: Lakehead (Port Arthur and Fort William) and Sault Ste. Marie with a 1962 deadline; and Sarnia and Windsor with improvement planned by 1959. It is understood that a comprehensive plan for developing Port Arthur and Fort William into a major terminal at the Lakehead has been sent by the Federal Department of Public Works to the mayors of these two towns and there is speculation as to whether a single harbour commission will be formed for a modern terminal built with central government help. Old rivalries between these two railway-owned ports still exist, and, while the present berths cannot be deepened to a required depth of 27-ft., new facilities cannot be acquired without purchase of some of the foreshore.

Saute Ste. Marie harbour is under direct federal government control and the Departments of Public Works and Transport have formulated schemes for improvements.

The harbour at Sarnia is also directly under the federal government, while at Windsor there is now in operation a harbour commission, though any capital expenditure on construction there is still likely to be backed by the federal government.

Chief among the commodities carried by the Great Lakes shipping in iron ore which is transported from the mines in the Lake Superior area to the steel mills of South Chicago, Detroit, the Lake Erie region and the Youngstown-Pittsburgh area. Other principal commodities carried are coal, petroleum and grain.

Personalia

Mr. J. H. H. Gillespie, B.Sc., A.M.I.C.E., A.M.I.Struct,E., has been appointed Assistant Chief Engineer to the Tyne Improvement Commission. Previous to his appointment, he was Engineer (Maintenance and General Duties), South-Eastern Division, British Waterways.

Mr. T. W. Farrer, F.R.I.C., A.I.M., formerly of the Chemical Research Laboratories of the D.S.I.R., Teddington, who has recently completed a programme of corrosion research, has joined Spencer and Partners, Consulting Engineers, London.

Timber Engineering and Research

Associations Laboratories at Beaconsfield

If timber is to continue to maintain its place as one of the main engineering materials for marine use, it is essential that more information should be forthcoming concerning the activities of marine timber borers. Around our coasts the shipworm *Teredo* and the gribble *Limnoria* are responsible for considerable damage to susceptible timber species. Their depredations can be virtually eliminated or appreciably retarded by the use of resistant species or adequate preservative treatments of the right type.

At a press day held recently at the Timber Development Association's Research Laboratories near Beaconsfield, Bucks, a description was given of the work taking place to ascertain which species of timber offer the best natural resistance to marine borer attack. Tests are being carried out at Shoreham Harbour and at Poole and are shortly to be initiated at Southampton. Investigations are also proceeding, in collaboration with the British Wood Preserving Association, on a wide range of preservatives and methods of application.

Recent work in Germany and the U.S.A. and at the Forest Products Research Laboratory, Princes Risborough, England, indicate that fungi living in the sea cause a type of "soft rot" deterioration previously associated mainly with cooling tower timbers. This type of deterioration is itself unlikely to be of importance but as it produces a softening of the surface it may make timber more susceptible to both *Limnoria* and *Teredo* attack.

An interim report on the studies at Shoreham states that the method used there consists of the suspension beneath a jetty of rectangular frames, 6-ft. by 4-ft., to a depth approximately 2-ft. below the surface of the water and extending to a depth of 8-ft. Each frame has seven horizontal metal rods, 10-in. apart on which are attached blocks of different varieties of timber. It has been found that of 24 species of timber tested, two were highly resistant—okan showed no sign of attack by marine borers after six years' immersion and basralocus was resistant after four years. Three other species, afrormosia, opepe and pyinkado were partially resistant and were slightly attacked by borers after six years' immersion but the attack never became extensive.

The degree of *Teredo* infestation is difficult to assess without damaging the test blocks. Investigations are proceeding to determine if burrows can be demonstrated by X-ray methods, and this aparatus will be employed for the first time at Shoreham during the annual inspection in October.

The resistance of timber to *Limnoria* attack has not been exhaustively investigated, especially as in field trials differentiation between *Teredo* and *Limnoria* attack has not always been adequately observed. In some localities where *Teredo* does not occur it may be important to know *Limnoria* resistance only. In order to investigate resistance of timber and preservatives to *Limnoria* attack, laboratory tests are being initiated with animals which are maintained under laboratory conditions.

Experiments with Timber Roofing

Part of the T.D.A. experimental programme is concerned with the development of timber shell roofs. Three forms of shell are being considered; cylindrical, hyperbolic paraboloid and conoid.

The work of cylindrical shells has been mainly theoretical. The methods of analysing the force distribution commonly employed for the design of reinforced concrete shells has been modified to allow for the variations in the elastic properties of timber at different angles to the grain. Using these modifications the design of simple cylindrical shells presents little difficulty.

The outstanding problem concerns the possibility of the shell "buckling" that is, suddenly losing shape and collapsing at stresses below the safe working stress.

On the proving ground, a model of a cylindrical shell 15-ft. x 14-ft. 6-in. in plan with a height from edge to crown of only 1-ft. has been erected and loading tests will be performed on this model to see whether failure occurs by buckling.

Eighteen months ago designs of hyperbolic paraboloid shells were prepared for a large span multiple hyperbolic paraboloid timber shell roof for an extension to the Royal Wilton Carpet Factory at Wilton, near Salisbury. The construction proved to be very simple and economical, and at present there are several more roofs of this form under construction.

In order to varify the design of the Wilton roof, a $\frac{1}{4}$ scale model was made of a portion of the roof and loading tests brought out several factors that the simple theory used could not explain. A theory has been developed which should be able to account for this behaviour, but this leads to mathematical difficulties which have not yet been satisfactorily overcome.

Work has also been carried out on small prefabricated plywood roof units for use in farm buildings. A full-size prototype of a unit has been fabricated and this behaved satisfactorily under loading tests.

Although the first concrete conoid shell was constructed more than 20 years ago, very little attention has been given to the design of such shells nor has much experimental work been carried out.

A model measuring 34-ft. x 12-ft. on plan with a rise of 4-ft. to the highest point is under construction in the Mechanical Testing Laboratory. The purpose of this model is more to show what the actual problems of design are rather than to check any existing theory.

Book Review

Progress in Cargo Handling, Volume II: Report of papers and discussions at the General Technical Conference of the International Cargo Handling Co-ordination Association, Hamburg 1957. Published by Iliffe & Sons, Ltd., Stamford Street, London, S.E.1. Price 63s. net, postage 1s. 9d. 306 pages including 14 pages of art plates.

Since its inception, a relatively short time ago, the International Cargo Handling Co-ordination Association has made considerable progress in its endeavours to reduce time and money spent on cargo handling and to promote new ways of tackling old problems. The Association's international meetings are now an established platform for the dissemination and exchange of information. The proceedings of its third general technical conference, held in Hamburg last year, have now been published in this book which presents each of the seventeen papers read in full, the discussions arising from them, the resolution adopted by the Conference and a description of the port of Hamburg.

The expenses incurred while a ship is in port amount to a very considerable sum each year and often equal half the total cost of maritime transport. During recent years great progress has been achieved in the handling of general cargo on quays and in transit sheds. The use of fork-lift trucks and other mechanical appliances have reduced the effort required from port workers and materially reduced handling time. Handling methods on board ship have not, however, made comparable progress. Consequently, the International Cargo Handling Co-ordination Association resolved at its second General Conference to study means of improving handling operations by reducing their cost and by decreasing the time of a ship's stay in port. The results of this investigation were embodied in the papers, which were grouped under four main headings: Cargo Handling on Board; Cargo Marking; Containerisation; and Handling of Fruit and Vegetables.

The first symposium, in addition to a survey carried out by the French National Committee of I.C.H.C.A. of the whole problem of handling general cargo on board, contains papers on research, mechanisation techniques, pocket elevators, stowage and container ship design. Symposium 3 has supporting papers on amphibious containers, transport ferries and transportation of freight by air, and Symposium 4 is devoted to the transport and discharge of perishable cargoes, with special reference to fruit and vegetables.

This volume will be found of value not only by those who hold responsibility in some branch of cargo handling, but also by many at other levels who require an up-to-date textbook from which they may gain ideas to improve efficiency in their own field of activity.

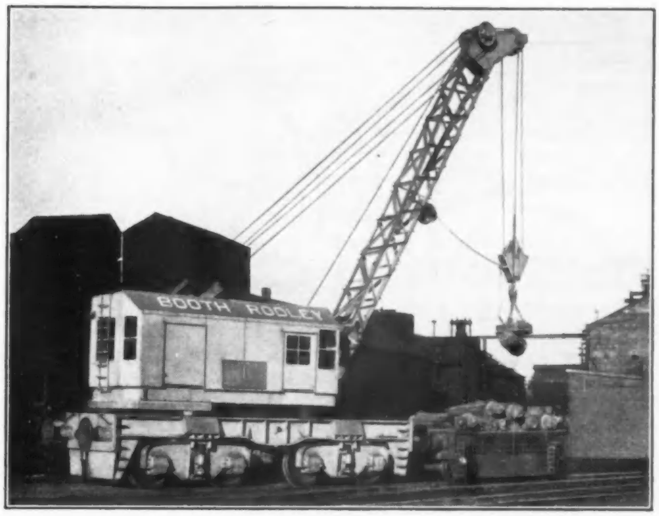
A New Dock Railway Locomotive Crane

Lifting Capacity of 10-15 tons

The movement away from steam to the standard diesel engine as a prime mover for the locomotive crane has been a gradual process, and individual dock and harbour authorities have found it necessary to make independent investigations into the economics of their decision to leave steam. By and large it can be stated that despite the inherent disadvantages of a diesel drive, namely lack of flexibility, a non-reversing prime mover and the necessity for skilled and regular maintenance, most dock authorities have made, or are in the process of making, a gradual change-over from steam to diesel power for locomotive haulage and craneage. In particular the lack of flexibility of the diesel engine makes itself felt when attempting to design a locomotive crane capable of dealing with the heavier loads while keeping the structure within the normal loading gauge. A successful design has met this problem by the use of electric transmission of the diesel power, with individual electric motors driving each of the four motions. In this case the power of the generator and motors is normally kept to a minimum required in order to avoid excessive cost.

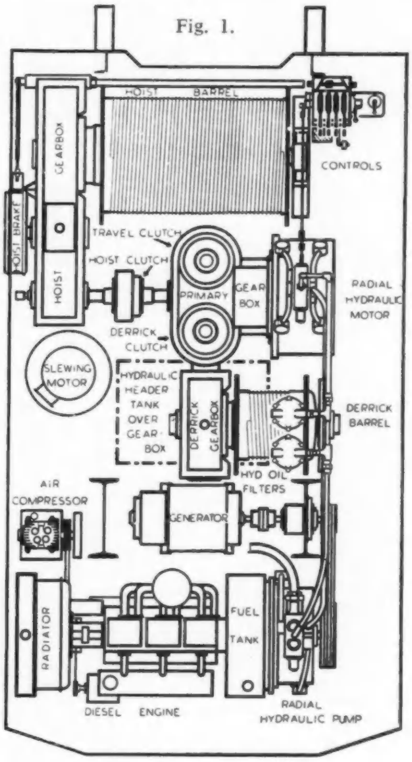
A new 10/15-ton locomotive diesel crane, which has recently been developed by Clyde Crane and Booth Ltd., Rodley and is now in production, employs hydraulic transmission for all motions except slewing. Here a 75 h.p. McLaren Type M motor drives a radial hydraulic pump which transmits power through high pressure piping and control valves to a hydraulic motor coupled to the primary drive shaft.

It will be seen from reference to Fig. 1 that power is taken from the primary drive shaft through a gearbox by air-operated multi-plate friction clutches for the hoisting, derricking and travelling motions. It is interesting to note that the drive transmissions generally incorporate gears mounted on hollow quill shafts driven by splined shafts engaging inside them. The normal use of bevel gearing for right-angled drives has generally also been superseded by totally-enclosed hollow-faced spiral gears running in oil baths. The use of spiral gears in place of bevels allows each wheel of a pair of mating gears to be supported by bearings on each side. Fig. 2 shows a diagrammatic section through the primary drive shaft and, on the left, the arrangement of the travel gear for the four-axle twin bogie carriage version. (There is also a four-axle carriage version for use where headroom is important.) In the case of railway cranes where free travelling in train is required, it has not been possible to adopt an enclosed final drive on this motion.



The twin bogie version of the crane shown operating with magnet lifting gear.

Fig. 1.



With the standard 35-ft. jib, the crane will perform hoisting duties as shown below with the superstructure in any position relative to the carriage:

Radius	Max. Working Load. Free on on Rails	Max. Working Load. Propped
16-ft.	10 tons	15 tons
18-ft.	8¼ tons	12½ tons
20-ft.	7 tons	10½ tons
22-ft.	6 tons	9 tons
26-ft.	4½ tons	7 tons
30-ft.	3½ tons	5½ tons

The standard jib gives a maximum height of lift of 27½-ft. above rail level, the maximum wheel loading being 12.65 tons with 10 tons on the hook. The following are the normal full speeds of the various motions:

Hoisting on single rope: 5 tons at 108-ft. per minute and 2½ tons at 216-ft. per minute.

Hoisting on three falls: 15 tons at 36-ft. per minute and 7½ tons at 72-ft. per minute.

Derricking, full travel: 34 seconds on high ratio.

Travelling: 4½ m.p.h.

Slewing: 1½ revs. per minute.

The independent D.C. slewing motor develops 7.5 h.p. at 1,000 r.p.m. The main generator, which also serves the crane lighting and magnet lifting gear if required, is a 12-Kw. or 10-Kw. variable speed set manufactured by B.T.H. Ltd. A Westinghouse Type E13C compressor, Westinghouse

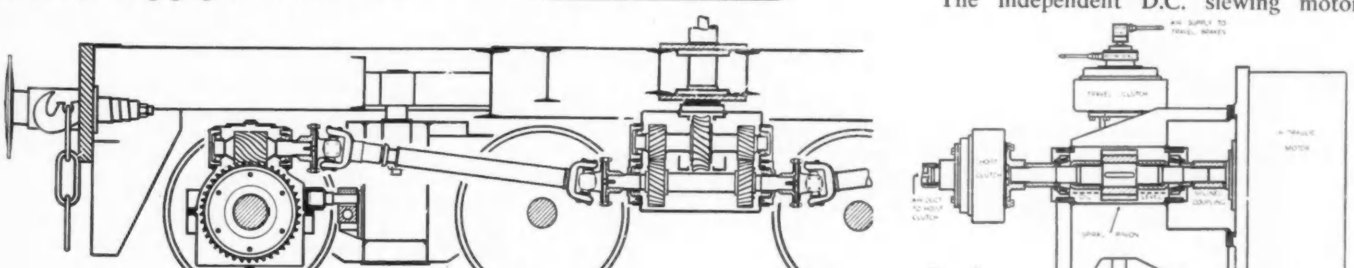


Fig. 2.

A New Dock Railway Locomotive Crane—continued

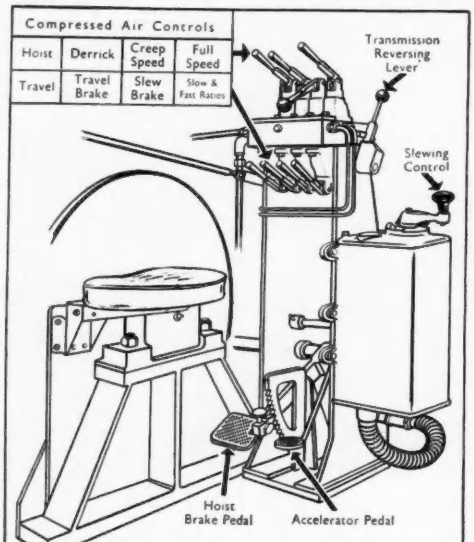


Fig. 3.

travel brake cylinders, Wellman-Ross air lever controls, and air clutches and slewing brake of Booth manufacture, comprise the principal air operation equipment. The controls for this, and the direct controls, are shown in a diagrammatic layout at Fig. 3. It will be seen that a foot pedal is provided which operates a mechanical brake on the hoist intermediate shaft, but the hydraulic drive system allows safe lowering of the load without the use of this brake. Safe load indication is by Vickers-Nash or B. and A. equipment.

The principal feature of the design of this crane, however, remains the hydraulic transmission system, which is manufactured by Leeds Engineering and Hydraulic Co., Ltd. The transmission is filtered mineral oil working in an enclosed circuit and compressed to a working pressure of 2,000 lbs. per sq. in. by an 18-ram radial type pump, mounted directly on the prime mover. Air-operated needle type valve gear is interposed in the piping, connecting to a 16-ram hydraulic motor, and both units being designed for long service without attention, are sealed after final assembly. Full torque is available for a heavy lift on creep speed which is obtained by reducing the number of rams in the pumping system, the hydraulic pressure developed being a function of the torque on the motor. The pump maximum delivery is approximately 50 gallons per minute, and at this output the motor develops about 55 h.p. at full torque. A range of high speeds with light loads is available by reducing the number of rams in the motor circuit. A spring-loaded relief valve, operating at about 2,500 lbs. per sq. inch, is provided in the circuit to protect the system against overload. The makers claim that the transmission system has several advantages, among which compactness and flexibility are evident. Drive reversal is obtained simply by reversal of the fluid flow, throttling of the exhaust fluid is used for braking the motion, and speed changing and reversing can safely be effected with the machinery in motion—when excess hydraulic pressure is by-passed through the relief valve.

A study of the constructional details indicates that the crane is of substantial construction and incorporates good engineering design.

Port of London Traffic

Increase in Tonnage and Cargoes Handled

The 49th annual report of the Port of London Authority for the year ended March 31, 1958, states that the volume of shipping entering and leaving the Port during the year totalled 75,242,200 net register tons, an all time high level, being over 3,650,000 tons greater than the record figure of last year. The net register tonnage at 34,053,178 using the Authority's dock premises was over 1,700,000 tons more than in the preceding twelve months. The tonnage of goods passing through the Port also reached a new high level, totalling 55,489,392 tons, which was over a quarter of a million tons more than the record traffic of the year ended March, 1957. Tonnage of goods imported from overseas showed a small reduction, increased traffic in certain commodities, particularly sugar, wood and grain, being offset by reductions in the tonnages of other goods, namely petroleum, coal and iron and steel manufactures. The tonnage of exports to foreign countries fell by about 400,000 tons in the year, largely due to a reduction in the shipment of cement. Coastwise trade was some 500,000 tons up, a large increase in inward coal traffic being mainly responsible.

The volume of imports handled by the Authority—as distinct from that dealt with in the Port as a whole and excluding the large tonnages handled by the Authority's tenants—showed an increase of just under 100,000 tons over that of last year, while the tonnage of exports handled by the Authority remained much the same. Imports, accommodated by the Authority increased by over 40,000 tons as compared with the previous year and the stock of goods in the Authority's direct charge at the end of the year showed an increase of approximately the same extent over the stock held a year earlier.

The total net register tonnage of vessels in the Foreign and Coasting Trade that arrived and departed with cargoes and in ballast during the year, excluding naval vessels and vessels with naval crews requisitioned or chartered for naval or military transport service, but including vessels on Government service with mercantile crews even if engaged on operational duties, was 75,242,200.

The net register tonnage of shipping that used the Wet Dock premises of the Authority during the twelve months ended 31st March, 1939, 1957 and 1958, respectively, was 34,053,178 as compared with 32,350,622 in 1957 and 34,713,344 in 1939.

The shipping entering the Dry Docks of the Authority during the twelve months was 3,348,500 tons gross, compared with 3,136,471 tons gross in the previous year and 3,077,170 tons gross during the year ended 31st March, 1939. These figures are given in terms of gross tonnage as that is the basis on which dry dock dues are levied.

The tonnage of imported and exported goods, foreign and coastwise, through the Port of London for the twelve months ended 31st March, 1939, 1957 and 1958, respectively, was as follows:—

	1939 *Tons*	1957 *Tons*	1958 *Tons*
Imports—			
Foreign ...	16,710,370	20,517,191	20,492,965
Coastwise ...	15,659,565	20,441,354	20,822,413
Transhipments ...	1,728,380	2,320,138	2,417,106
	34,098,315	43,278,683	43,732,484
Exports—			
Foreign ...	3,461,287	6,689,218	6,282,661
Coastwise ...	2,374,081	2,938,950	3,057,141
Transhipments ...	1,728,380	2,320,138	2,417,106
	7,563,748	11,948,306	11,756,908
Total ...	41,662,063	55,226,989	55,489,392

Improvement Works

As far as improvements to the Port are concerned, the Report states that premises and plant have been efficiently maintained, and the policy of overhauling and improving the entrance locks and the sealing of those no longer required continues. At the India and Millwall Docks the sealing of the Millwall Dock Entrance has enabled the maximum impounded water level to be raised to 2-ft. 6-in. above Trinity High Water and thereby accommodation for vessels of deeper draught is provided.

Details of the principal works completed and proceeding during the year are as follows:—

London and St. Katharine Docks and Uptown Warehouses

The rebuilding of Shadwell Basin jetties has been completed.

The major overhaul of the St. Katharine Dock Entrance Lock has been started and work in connection with the closing of the Wapping Entrance Lock continued, the inner dam having

Port of London Traffic—continued

been completed. The Garnet Street middle lock gates have been overhauled.

At Cutler Street Warehouse, an overhead lifting gantry has been installed, central heating completed in Nos. 1 and 2 East India Buildings, and facilities for storing, handling and bottling wine are being improved and extended. At St. John Street Cold Store the floors of Nos. 1 and 2 Chambers have been reconstructed, and a device incorporated to obviate frost heave.

Surrey Commercial Dock

The construction of a new bridge with increased clearance over the Canada/Greenland Passage and other works, including tunnels for sewers and services, in connection with the widening and deepening of this cutting are proceeding satisfactorily, despite the difficult geological conditions which have been met in the course of the work.

Two sheds for timber storage in Acorn Yard have been completed and No. 12 Shed, Greenland Dock, extended. Further concrete alleyways have been laid to serve open timber storage in Baltic and Canada Yards.

Modern delivery office accommodation has been provided and two houses for Senior Police Officers have been built. Work has commenced on an A.C. electrical distribution system to reinforce and ultimately to replace the existing D.C. system.

India and Millwall Docks

The overhaul of all lock gates at Blackwall Entrance has now been completed.

A new electricity sub-station for high voltage A.C. supply has been completed at East India Dock and a workshop installed at West India Dock for the maintenance of radio-telephony equipment. A modern office block has been completed at Northern Department, Millwall Dock, and a new shed for hardwood storage at Junction Dock is in the course of erection. The re-roofing and re-sheeting of " A," " B " and " C " Sheds, Millwall Dock, and Nos. 10-13 Sheds, West India Dock, is proceeding. Overhaul of the permanent way at Harrow Lane sidings is continuing.

Royal Victoria Dock

Additional railway sidings have been constructed on the site of the former " L " Warehouse.

The Western Entrance has been closed to traffic due to continued deterioration of the inner lock gates and a dam is to be constructed across the inner end of the entrance to stop leakage of impounded water.

Royal Albert Dock

Repairs to the Gallions Upper Entrance (Barge) Lock, including the fitting of new inner and outer gates, are in progress together with the replacement of a section of the upper jetty. Improvements for handling road vehicles at the loading bays between Nos. 21-23 and Nos. 25-27 Sheds on the north side of the Dock have been completed.

King George V Dock

The high voltage A.C. ring main has been completed and work on the low voltage distribution system is proceeding. The new electrically-operated hydraulic pumping station, replacing the steam hydraulic pumping station at Royal Victoria Dock, has been completed. The renewal of floors and drains of Nos. 7/9 Sheds has been completed.

Work on the comprehensive post-war programme for the renewal of the rail track at this Control has continued, the final stage having now been started.

Accommodation for shipworkers at the Eastern, Western and King George V Dry Docks has been completed and at the Eastern Dry Dock the adjacent roadway for the heavy-lift berth has been reconstructed.

Tilbury Dock

The passenger reception facilities at No. 1 Berth and the new shed at No. 2 Berth have been completed, and both are now in full operation. The track for the new 35-ton dry dock crane has been completed and construction of the crane commenced. The keel blocks in the North-Eastern Dry Docks have been renewed.

A further section of the east-west main dock road is under reconstruction.

All six of the new diesel-electric locomotives have now been received and facilities established for their maintenance, so that the change-over from steam haulage at Tilbury Dock is now effected.

Surveys

In connection with the investigation into the problem of siltation, monthly surveys of Barking and Gravesend Reaches were continued, in addition to the normal programme of survey work undertaken by the Hydrographic Section of the Harbour Service which included fifteen main surveys of various Reaches of the River and fourteen of the Docks.

To assist in making an accurate assessment of the facilities which could be provided in the Port for the reception of deep-draughted tankers, special surveys were undertaken by the Admiralty, at the request of the Authority in consultation with Trinity House, of the estuarial approaches to the Port. The surveys disclosed that since 1956 a bar across the inner end of the South Edinburgh Channel has developed, reducing the governing depth to 31-ft. at low water, while in the North Edinburgh Channel, depths have improved at the inner and outer ends (the areas which formerly restricted its use) and a good fairway is available with a governing depth at low water of over 36-ft. Trinity House have altered the buoyage in these Channels, the buoys in the North Channel being so arranged as to mark a channel with a minimum depth at low water of 36-ft.

Siltation and Dredging

Progress has been made with the scheme for the future disposal of dredging ashore. Construction of the necessary pumping plant and craft is proceeding and tenders have been invited for the earthworks required to prepare the Coldharbour site at Rainham to receive dredgings.

During the year, 965,000 tons of material were dredged from the River and 1,903,000 tons from the Docks, the quantities removed during the previous year being 747,000 tons and 1,993,000 tons respectively. Necessary depths have been maintained in the Docks despite the lesser quantity removed.

General

Additional units of plant including eighteen electric quay cranes, twenty-seven mobile cranes, two electric travelling hoists, one overhead transporter hoist, two wreck-marking boats, one diver's punt and three dummy pontoons have been received and put into service.

Three electric and nine hydraulic quay cranes have been completely overhauled together with numerous smaller items of plant.

Pollution

It is understood that the report of the Government's Departmental Committee on the " Effects of Heated and other Effluents and Discharges on the Tidal Reaches of the River Thames " is likely to be available towards the end of the current year. The prolonged and difficult investigations by the experts concerned have reached a stage which will enable essential data to be given to the Committee for the purpose of the report.

As regards the future control of pollution in the tidal River, the Authority have deemed it desirable to appoint a Chemical Engineer of high professional standing to advise them on technical considerations in this connection.

International Group to Collate Tidal Data

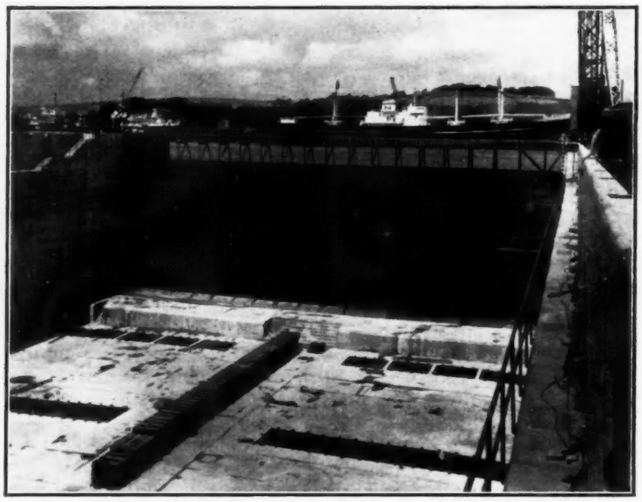
During a recent meeting of the International Council of Scientific Unions, it was decided to make the Liverpool Observatory and Tidal Institute the headquarters of an international group of specialists who will furnish information and assistance to all countries on tidal effects throughout the world. Dr. A. T. Doodson, director of the Observatory, has been appointed chairman of the group, which will meete at regular intervals to collate information.

Box Gate for Falmouth Dry Dock

Sir William Arrol & Co., Ltd., Glasgow, have recently installed a "Box" type dry dock gate for the new Queen Elizabeth Dry Dock at the Falmouth Docks of Silley, Cox & Co., Ltd. This type of gate was invented by the late Mr. Edward Box, M.I.C.E., and a number have already been built for docks in this country and overseas.

The gate at Falmouth Docks is a single leaf flap type of welded steel cellular construction hinged horizontally on the end bearings at sill level. Having a steel weight of 500 tons it is the largest of its type to be constructed and is simple and speedy in operation, being raised or lowered in a few minutes by an electrically driven winch.

During recent years the "Box" gate has found increasing favour with graving dock owners because of the advantages which it offers over the traditional mitre type gate. An important



Box flap gate at Queen Elizabeth Dock, Falmouth.

advantage is that in the open, or lowered, position it can usually be accommodated in the outer basin or waterway adjoining the dry dock. In comparison with mitre type gates which require recesses in the dock walls for the accommodation of the gates in the open position this new method reduces the cost of dock wall construction. Alternatively, if a given space is available, a greater useful length of dock can be obtained with this type of gate. This length saving feature can increase by 20 to 40-ft. the effective length of an existing dock, or in the case of a new dock, can reduce the cost of construction by an amount approximating to the cost of the gate.

The system of framing adopted may be varied according to the size and to the width-height ratio of the gate. The usual arrangement of horizontal ribs forming girders spanning between the side jambs of the entrance with vertical intercostal ribs from keel to top deck, has given way in some recent instances to a system of main vertical ribs spanning from the keel to a top horizontal girder of stiffened box construction. Within the confines of the skin plating which covers both sides of the gate, water-tight compartments are formed to act as buoyancy chambers for the purpose of reducing the loading on the operating gear and on the gate bearing under working conditions. Other compartments of the gate form tidal chambers, being fitted with scuppers to give access to the water. Flooding of the lower ballast compartments is controlled by valves, enabling correct balancing of the gates during the preliminary manœuvring and stepping into its position at the dock entrance, and for any subsequent removal which may be necessary.

The traditional material forming the meeting faces of the gate at sill and jambs is Greenheart timber, which is carefully dressed after fitting to the gate to give water-tightness when the gate is closed against the dock entrance. The fitting of an "L" shaped rubber seal to the edge of the Greenheart gives added security in this respect. In a few gates recently constructed, steel billets with an inserted rubber seal, and in a few cases stainless steel inserts in the concrete jambs and sill, have replaced the timber meeting faces. These innovations, however, have not yet been proved in long service. The gate is pre-fabricated at the works in sections suitable for transport and can be assembled complete on the dock floor as soon as the requisite area of the floor has been concreted. On completion and flooding of the dock the gate is floated to the entrance and stepped into position.

Operation of the gate is by an electrically driven winch situated on one side of the dock, from which a wire rope is led over pulleys to an anchorage on the far side of the dock. All controls are by push-button and in raising the gate a limit switch cuts out the motor a few inches in advance of the fully closed position, and an "inch raise" button is provided for stalling the gate against the jambs. A fluid coupling incorporated in the winch drive prevents any overloading which might arise should water be temporarily trapped in the tidal compartments while raising the gate.

In addition to the main motor, the winch is fitted with a slow speed auxiliary motor which operates at the commencement of the gate lowering operation, during which the gate falls away slowly. When it has fallen through several feet and the rope tension increases, a limit switch cuts out the auxiliary motor and brings in the main motor. As the gate is further lowered into the water, the tidal compartments are flooded through scuppers, and in low tide conditions the gate may become temporarily buoyant through restriction in the quantity of water entering the flooding compartments. Under these conditions the rope slackens off and a limit switch cuts out the main motor and brings in the slow speed motor. A time lag is set to cover the flooding period in this condition, after the main motor again takes over, being cut out by a limit switch when the gate reaches the fully lowered position.

"Box" gates have now been installed at Glasgow, Peterhead, Falmouth, Dover, North Shields, Colombo and Singapore.

Artificial Blocks for Wave Protection

It has been the practice for very many years in the construction of sea defence works, causeways and breakwaters, to use precast concrete blocks ranging in weight from, perhaps, 1 ton to over 20 tons. These blocks have been particularly favoured in situations where large, natural quarried rocks were not readily available or transportable and they were usually of cubical shape, although other shapes such as the tetrahedron were sometimes encountered in aprons and spillways dealing primarily with scour and erosion.

Since the war, considerable research has been undertaken to develop more effective forms of precast concrete blocks for this purpose and, some eight years ago, a patented block, the Tetrapod, was put forward by a famous French hydraulic engineering concern. These blocks have been quite widely used in many parts of the world and they have generally proved remarkably effective.

A facing formed of these blocks interlocked one with another provides a high degree of roughness and permeability. The voids ratio is slightly greater than 50% and remains practically the same however the tetrapods are placed. The dissipation of wave energy is effected by division of the mass of water into smaller turbulent streams which collide with each other in the interstices of the facing. The legs of the block facilitate interlocking and the slope can be steepened to nearly 1 : 1. In using the Tetrapod, it is generally possible to reduce the individual weight of the block, the total volume of facing concrete and also the slope.

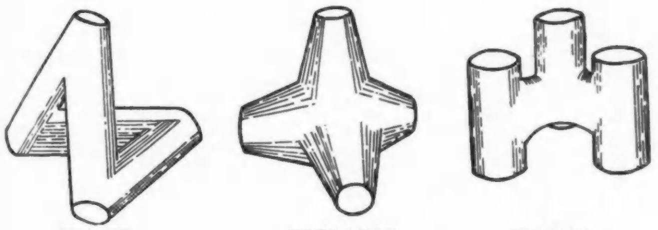
Other forms of precast facing blocks have been studied, in particular in the U.S.A. and Great Britain, although they have not yet reached the degree of development and use of the Tetrapod. An American form, called the "Tribar" has been extensively studied at the Waterways Experiment Station at Vicksburg and has apparently shown even better stability than the Tetrapod under certain circumstances. The Tribar has three

Artificial Blocks for Wave Protection—*continued*

vertical drums joined by horizontal connecting ribs. Its shape and stability is particularly favourable for single layer placement above water level, although it has not yet been proved that it will possess the same stability whichever way it is dropped and its voids ratio might well be less than that of the Tetrapod.

It is intended to adopt Tribars weighing 17.8 tons and having drums 6½-ft. in height and 3¼-ft. in diameter for breakwater armouring in Hawaii.

In Great Britain patent rights are being sought for the "Stabit" concrete block, the weight of which may vary at least from 5 to



STABIT TETRAPOD TRIBAR

Three shapes of precast concrete blocks used for sea defence works.

25 tons, according to the severity of wave conditions at any particular site. Model tests have indicated that this type of block is most effective in stabilising slopes and dissipating wave energy, as well as knitting together extremely well when placed at random as a facing or in a pile. Voids are equal to approximately twice the volume of the unit whereas, in the case of Tetrapods, the volume of voids in a mass of blocks is roughly equal to the volume of concrete.

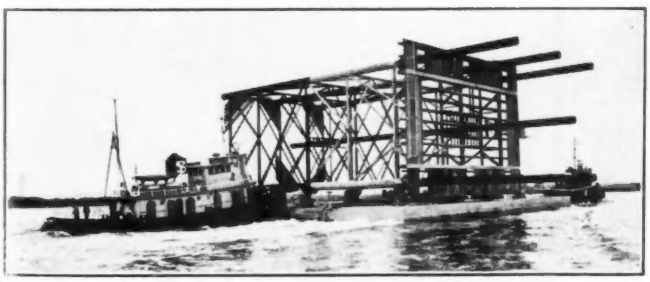
The Stabit block has not so far been used in practice, although it is expected to be employed shortly for coastal protection work.

Manufacturers' Announcements

Launching Platform for Offshore Drilling

A new unit known as a controlled platform launching barge which is expected to reduce appreciably the cost of installing and recovering offshore drilling platforms, has been announced by Coastal Marine Drilling and Construction Corp. Houston, L. B. Christenson Engineers, Inc. Texas, and Todd Shipyards Corp. New York.

Present platform installation methods require the use of a derrick barge with at least four auxiliary craft. The operation often takes from seven to fourteen days and costs upwards of $100,000. By contrast, the controlled platform launching barge



Launching Platform being towed to drilling site.

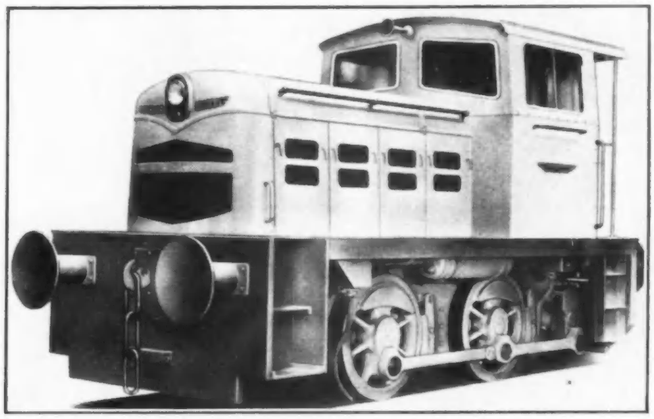
method normally completes the installation within four to five days. The placing of the platform on the ocean floor requires only two hours, and the remaining time is spent driving and welding the steel piles which secure the platform to the bottom. Pilings are placed in each leg of the platform at the time of its construction, and this further expedites installation at the drilling site. It is claimed that overall installation costs are reduced by at least one-third, since faster platform installation lessens the risk of operations being interrupted by bad weather.

The new-type launching barge consists of two barges which are hinged together and measure 130-ft. x 56-ft. and 130-ft. x 32-ft. respectively. The barges carry the platform from shore to drilling site, and are carefully positioned; then one of the barges is gradually submerged through a 90° arc by the combined action of ballasting and four hydraulic rams. While being transported the platform rests on its side on both barges, but at the time of launching it is fastened only to the submerging barge, and therefore moves downward into the water from a horizontal to a vertical position. Once upright and resting on the bottom, the platform is automatically released from the barge, which is gradually returned to its original horizontal position on the surface, and the platform is secured to the bottom with its integral steel pilings. The entire procedure is reversed when it is necessary to recover the platform and move it to another location.

The new equipment has already set one platform in 53-ft. of water approximately nine miles off the Louisiana Coast, and a well is now being drilled. The present barge can also place larger platforms weighing up to 850 tons in as much as 120-ft. of water.

New Diesel Hydraulic Shunting Locomotive

Last year Messrs. John Fowler & Co. (Leeds) Ltd., in collaboration with Messrs. Self-Changing Gear Co., Coventry and Messrs. Leyland Motors, started production of an entirely new range embodying Leyland 900 engines. The main feature of this new range is a single-stage Schneider torque converter, a range of these units up to 460 B.H.P. now being manufactured under licence in Great Britain by Self-Changing Gear Co.



The new diesel-hydraulic shunting locomotive.

A series of successful tests have recently been carried out under varying conditions, with a demonstration unit of a 185 B.H.P. 0-4-0 type, developing an initial tractive effort of 19,000 lbs. The principal advantages claimed for this transmission as compared with the conventional mechanical transmission incorporating a fluid coupling are, apart from simplicity of control, stepless acceleration with no loss of tractive effort when changing gear, good braking effect from engine and transmission when travelling down-grade with a load, exact control of wagon loads down to less than ½ m.p.h. whilst travelling over weigh-bridges and an economical fuel consumption.

Leading dimensions and characteristics of the demonstration locomotive are: overall length (over buffers) 21-ft., height 11-ft. 7-in., overall width 8-ft. 6-in., and with 3-ft. 6-in. diameter wheels and a wheelbase of 5-ft. 6-in. Top speed 12 m.p.h., 30 tons adhesive weight with 19,000 lbs. initial starting tractive effort.

The power unit is a Leyland/Albion six-cylinder normally aspirated four-stroke engine rated at 185 B.H.P., 12 hour rating, at 1,600 r.p.m. and attached to which is an 18D Schneider single-stage torque converter. From the torque converter the drive is taken through a Cardan shaft to a three-speed air-operated epicyclic gearbox and then to an air-operated forward and reverse

Manufacturers' Announcements—continued

unit, embodied in which is the reduction gearing and the main jack-shaft.

The driving controls are duplicated on either side of the cab and are conveniently grouped for operation. Forward and reverse indicator lights are fitted, together with safety devices which ensure shut-down of engine in event of excessive engine cooling water temperature, low lubricating oil pressure and excessive converter oil temperature.

The Schneider single-stage torque converter is capable of a three to one torque multiplication and the torque ratio is changed automatically with load conditions without interruption to the flow of power. This unit is the simplest form of torque converter, having a low oil charging pressure and no complicated oil seals. In series with the torque converter is a heat exchanger and a service oil tank and filter. The combination of Schneider torque converter with the epicyclic type gearbox is an excellent arrangement for the widely varying power requirements met with in industrial shunting yards.

This additional range of hydraulic-mechanical locomotives can be supplied as single or tandem units in a power range of 185 to 460 B.H.P., either as 0-4-0 or 0-6-0 types and for rail gauges between metre to 5-ft. 6-in., with initial tractive efforts of from 18,000 lbs. up to 40,000 lbs.

The Kwikform Systems of Formwork

Adaptable and economic in use in both large and small structures, the Kwikform formwork is easy to erect and strike and permits a fast pouring of concrete. It consists of only four basic components, aligners, wallforms, tie rods and tee head couplers. For heavy constructional work, with pours of up to 6-ft. of concrete at rapid rates of deposition, the equipment employed would be 6-ft. aligners, placed at 4-ft. 3-in. centres and filled in between with 4-ft. x 1-ft. Mark II forms. Twin tie rods connecting the aligners would be placed at 2-ft. centres vertically and 4-ft. 3-in. centres horizontally. A useful adjunct to this system is the aligner adjuster, a device which enables the thickness of the wall to be controlled without the use of cones and distance pieces.

Illustrations showing (left) use of supporting scaffold tube walers, which can be easily connected to aligners to hold first lift in position, and (right) a double face wall, showing protected edge to ply face.

The Mark II formwork system is suitable for single-faced work as well as for columns, beams, suspended floors and for circular construction of suitable radii, simply by inserting shaped timber fillers. By the use of slotted timber fillers which can be bolted in as an integral part of the system, almost any dimension can be achieved.

The Company also provides a plywood formwork system for building in concrete where large areas can be quickly fixed into position, thereby reducing labour and site costs. It incorporates plywood as a face for the concrete and the plywood edges are protected from damage by a metal strip. The aligners, 1-ft. wide by 10-ft. long are normally placed in pairs and 4-ft. apart. They are connected and held in position by means of the triple tie rod couplers which occur at 5-ft. centres horizontally, the vertical centres are arranged according to the pour.

To make it possible to use the Mark II steel forms in conjunction with the plywood forms, a special transfer aligner has been designed, 4-ft. wide by 10-ft. long. The back member of this is of standard scaffold tube, thus facilitating an easy connection for standard scaffold tube which can be used as a raking shore to hold the first lift in position. The forms, with dimensions ranging from 4-ft. wide by 5-ft. in height to 4-ft. wide by 4-in. in height, are connected to the aligners by means of tee head couplers as in the Mark II system. A combination of these sizes allows any dimension to the nearest 4-in. in height to be achieved. In addition, there is a special timber filler made in three different widths of 2-in., 1½-in. and 1-in.

As difficulty may be experienced in pouring from the top of a 10-ft. lift of shuttering, a hinged access panel has been designed.

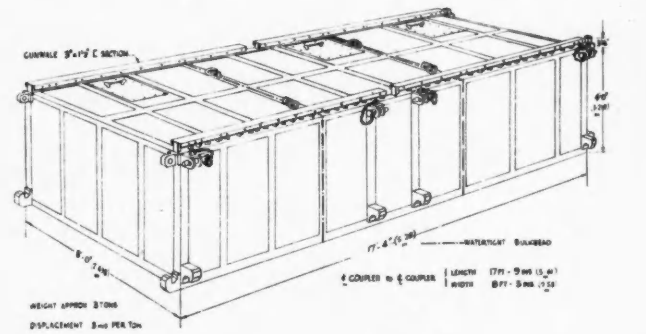
These systems of formwork are manufactured by Kwikform, Ltd., Birmingham 25.

The "Uniflote" Marine Construction Unit

The possibilities of using a platform composed of Uniflote units for a floating helicopter landing stage were demonstrated recently by Thos. Storey (Engineers) Ltd. These units have been developed by the Company for the past twelve months and can be used for a variety of tasks.

Basically the uniflote is a steel-framed tank with two internal water-tight bulkheads. Each unit is fitted with patent couplers which enable them to be connected quickly, and with the minimum of labour. The landing platform used in this instance was made from eight units of variable construction with four articulated ramps and power supplied by two Harbourmaster propulsion units. These engines can be fitted in any desired position on the Uniflote thus converting the platform into a ferry capable of carrying loads of up to 80 tons.

The first landing stage built of Uniflotes was set up at Nkata Bay, Lake Nyasa, about 12 months ago, since when it has been



Two Uniflotes coupled together.

subjected to considerable wave formation and storm action and is still adequately fulfilling its duties. Two further applications have now been developed and are in course of manufacture. The first is a Uniflote dumping barge which, being flat-bottomed, can also be discharged by grab or other suitable shovel equipment. The second is a mobile floating platform equipped with scaffolding for use in ship repairing, especially for working on the raking faces of the bows and sterns of ocean-going liners, thus affording facilities for complete repair work without the need for dry-docking.

During the coming winter, trials will be carried out in British coastal waters to prove the ability of rafts of Uniflotes to transport indivisible loads of up to 200 tons.